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ABSTRACT

This document presents findings from phase 1 of the Victorian Quality Schools Project. This phase, the first of a 3-year longitudinal study, sought to identify characteristics of effective schools and develop a model of teacher and school effectiveness. Data were derived from four instruments--parent questionnaires, teacher questionnaires, student records, and teacher records. The sample of 13,900 primary and secondary students and 930 teachers was drawn from a total of 90 out of 96 Catholic and independent schools in Victoria, Australia. Key findings are as follows: (1) The school profiles provide an effective framework for monitoring and reporting achievement; (2) schools have considerable influence on overcoming inequalities stemming from family socioeconomic status; (3) early childhood education is important for later achievement; (4) student attentiveness has a large effect on achievement; (5) the frequency with which students do homework varies among students, and the emphasis placed on it changes from primary to secondary school; (6) parental monitoring of homework is important for primary students; (7) teachers are generally positive about their work environments, but receive little feedback on their performances; (8) leadership plays a critical role in developing a positive teacher work environment; and (9) the key to improved educational outcomes is teacher effectiveness. Sixteen figures are included. Appendices contain 23 statistical tables. (LMI)

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SCHOOL AND TEACHER EFFECTIVENESS IN VICTORIA

Key Findings from Phase 1 of The Victorian Quality Schools Project

Peter W. Hill
Philip Holmes-Smith
Kenneth J. Rowe

Centre for Applied Educational Research
The University of Melbourne
Institute of Education

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BACKGROUND TO THE STUDY

Effective schooling

The provision of schooling is one of the most massive and ubiquitous undertakings of the modern state. Schools exert a near universal influence over the lives of young people for periods of 12 years or more. They are the chief means by which young people are educated and prepared for full and productive participation in society. Schools account for a significant proportion of public and private expenditure, as well as generating substantial paid employment.

Not surprisingly, there has long been an interest in knowing how effective the provision of school education is and how it can be improved (*e.g.*, Chapman *et al.*, 1991; Coleman *et al.*, 1966; Cuttance, 1992; DES, 1984; Goodlad, 1982, 1983; McGaw *et al.*, 1992; NCEE, 1983; OECD, 1983, 1989; Reynolds & Cuttance, 1992; Rutter *et al.*, 1979). In country after country, the question has been raised as to whether schools are meeting society's expectations of them. This is an especially sensitive issue at the present time given the level of consensus regarding the importance of school education as an element of micro-economic reform and in meeting the demands of the modern workplace (e.g., Dawkins, 1988; OECD, 1986). Concern about the quality of school education has become a high priority policy issue in all OECD countries. Attention has focused on the operational definition and measurement of the quality of schools, the identification of factors associated with effective schooling, and the use of such knowledge to achieve further improvements in quality (see, for example, Mortimore, 1991).

Early studies of school effectiveness such as those by Coleman *et al.* (1966) and Jencks *et al.* (1972) focused on the extent to which schools equalised opportunities for different groups within the community. The results seemed to point to the rather depressing conclusion that the influence of the school was insignificant compared with the influence of family background. Using different methodologies and asking different questions, more recent studies (e.g., Mortimer *et al.*, 1988a, 1988b) have focused on identifying common characteristics of 'good' or 'effective' schools (i.e., schools that are evidently performing much better than others with which they might legitimately be compared taking into account their student intake) and have come to the conclusion that schools do make a difference. Moreover, there is now widespread agreement among those reviewing the research that effective schools typically exhibit:

- strong educational leadership
- high expectations of student achievement
- an emphasis on basic skills
- a safe and orderly climate
- frequent evaluation of students' progress.

While these findings make intuitive sense, for the following reasons it is necessary to treat them with caution.

1. The empirical evidence in support of the conclusions reached regarding the characteristics of effective schools is not extensive, with much of it derived from small-scale case studies (see Banks, 1992). For example, Rutter and colleagues' influential 1979 study, *Fifteen thousand hours: Secondary schools and their effects on children*, was based on observations made in just twelve inner London schools. Moreover, most studies have included only small numbers of outcome and explanatory variables.

2. There have been few large-scale studies that have employed sample designs capable of providing valid generalisations about the characteristics of effective schools. Furthermore, until very recently, researchers have not had access to appropriate statistical tools with which to analyse the data from such studies. For example, access to multi-level analysis techniques has only been available in recent years (see Bock, 1989; Goldstein, 1987; Raudenbush & Willms, 1991). Only through the use of such techniques can proper account be taken of the organisational structure of schools, namely, the way in which whole classes of students relate to particular teachers, who in turn form the staff of a particular school (see Bryk & Raudenbush, 1989). Traditional regression analyses ignore this hierarchical clustering and commonly give rise to serious errors in estimating the influences operating at different levels.

3. Most previous studies have been cross-sectional in nature and have not allowed for the measurement of growth and change. As a result, they have had to report estimates of school effectiveness based on average achievement levels statistically adjusted for relevant intake charcteristics. The problem with this approach is that it tends to lead to serious underadjustments. Only through a longitudinal study is it possible to estimate with confidence the specific effects of schools over and above what students bring with them.

4. The identification of effective schools has been made on the basis of a wide range of operational definitions as to what it means to be a 'good' school. The most common method has been to choose those schools with scores on tests of reading and mathematics (or on public examinations), that are higher than average, after making adjustments for the nature of their student intakes. Studies such as those of Rutter *et al.* (1979) and Mortimore *et al.*, (1988a, 1988b) have investigated multiple outcomes, but provide little insight into the relationships among various outcome and explanatory measures and the extent to which effective schools are consistently above average across all measures. A recent major survey (McGaw *et al.*, 1992) has demonstrated that when the clients of schooling - parents, teachers and the community at large - are asked to describe what it is that makes for an effective school, they provide complex and multi-dimensional descriptions embracing many aspects of the total character of the school and the learning environment created by students, parents and teachers.

The project

The Victorian Quality Schools Project[1] is a research and development project which aims to develop strategies for both schools and the system as a whole that will lead to substantially improved educational outcomes. The research component of the project was conceived in the light of the international literature on school effectiveness research and the perceived limitations of that research. In addition, it builds on the outcomes of an earlier, four-year longitudinal study of factors affecting students' reading achievement undertaken within the Victorian Ministry of Education, known as the "100 Schools Project - Literacy Program Study" (Rowe, 1990, 1991a, 1991b; Rowe & Rowe, 1992a, 1992b).

The present study aims to provide answers to the following research questions:

- **What are the characteristics of schools in which students make rapid and sustained progress in English and Mathematics, after adjusting for their initial levels of achievement?**

- **What are the characteristics of schools in which there are positive student attitudes and behaviours, positive perceptions by teachers of their work environment and high levels of parent participation in and satisfaction with their child's schooling?**

In addition, the study aims to contribute developmentally towards other aims of the Victorian Quality Schools Project, namely:

- **to facilitate school improvement processes within participating schools, and**

- **to provide input to system-level quality assurance and accountability arrangements, policy development and planning.**

Study design

The overall design of the study is represented in schematic form in Figure 1. The major feature of the design is the opportunity to explore inter-relationships among factors at three levels (student, teacher and school) and over three time periods (1992, 1993 and 1994). This involves estimating the effects of factors at all three levels on a range of outcomes, as well as reciprocal relationships. An example of a reciprocal relationship would be the influence that schools and teachers have on students and in the opposite direction, the influence that students have on teachers and schools.

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[1] Formerly known as the "150 Schools Project"

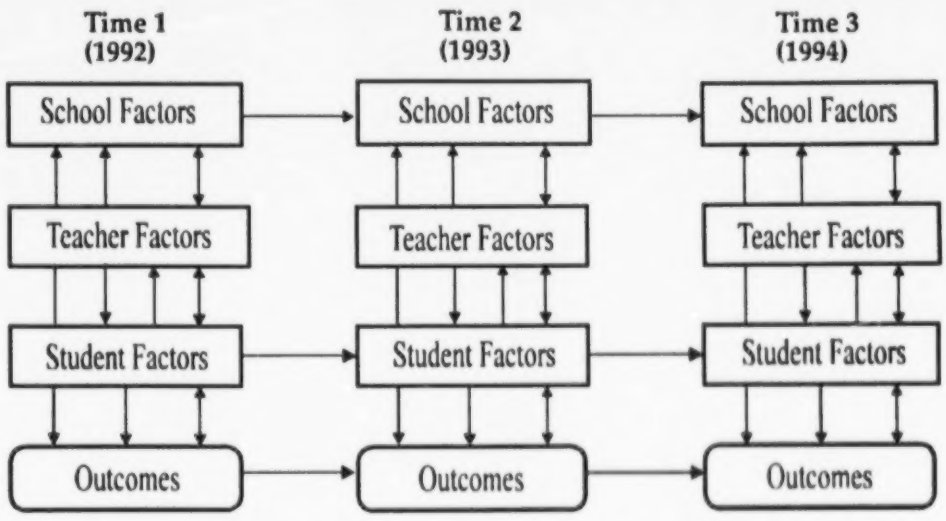


Figure 1. Schematic model of the study design

In more detail, the study design incorporates several unique or unusual features, including:

- a large sample of schools involving all students in each of five different Year levels, thus ensuring generalisability of findings and enabling class and teacher effects to be estimated properly
- the use of multiple outcome measures, including students' achievements in English and mathematics, student attitudes and behaviours, teachers' perceptions of their work environment, and parent participation in and satisfaction with their child's school
- the use of a longitudinal design to monitor students' progress and growth, as well as other changes within the school over time, and
- the use of analytic methods that allow full exploration of interrelationships among factors at each level of analysis, as well as the simultaneous estimation of the effects of factors at the student, teacher and school levels on rates of student progress, adjusting for initial achievement levels.

The sample

The study uses a stratified probability sample of government and non-government primary schools and secondary colleges. The sample is designed to provide estimates which are accurate within 95% confidence limits.

The sampling procedure involved a two-stage cluster design was used in which schools were selected with probability proportional to size at the first stage, and entire year levels in the selected schools at the second stage. In 1992, data were collected from the entire cohort of students (and their parents and teachers) in year levels Prep, Year 2, Year 4, Year 7 and Year 9. Repeated measures for those students remaining in the sampled schools will be obtained in 1993 and 1994, as follows:

Following written invitations, a total of 96 schools agreed to participate in the study. Useable data were received from 90 school sites, representing a response rate of 88.5 per cent. The number of schools that agreed to participate in the study was considerably smaller than anticipated due to a number of factors, including industrial action within government schools aimed at preventing the use of profiles in obtaining measures of achievement. On the other hand, the number of students for whom data were returned was higher than expected. The achieved sample in 1992 was distributed as shown in Tables 1.1 to 1.3 of Appendix 1. In summary, the achieved sample comprised 13,909 students and 931 teachers from 90 school sites.

Procedure

A set of four instruments was used in 1992:

1. Parent Questionnaire
2. Student Record
3. Teacher Record
4. Teacher Questionnaire

Following invitations to sampled schools to participate in the project, one teacher from each selected school was invited to attend a professional development day to learn about the specific objectives, design and school-based administrative requirements of the project. Programs were run in each of the eight regions during August 1992. The selected teachers were then asked to train other teachers in the school where more than one class was involved.

Undertakings were given that absolute confidentiality of data sources would be strictly maintained and individual students, teachers or schools would not be identified, nor would inter-systemic comparisons be made. It was also agreed that individual school- and student-level data would be returned to the school and would remain its property.

Measurement of variables

Tables 2.1 and 2.2 in Appendix 2 summarise characteristics of the measures used in the study. Related technical details are provided in Appendix 5.

Student home background characteristics

The *Year Level*, *Age*, *Gender*, postcode of the student's residential address, whether the student was an *Aboriginal/Torres Strait Islander*, and whether the student was enrolled under the *Integration Program*, were recorded for each student. Students residing in areas/towns with a population of <25,000 were identified as *Rural*. A variable called *Socio-Educational Level* was measured for each student's family. This variable was a weighted composite comprising: the higher of mother's or father's occupational status using the Australian Bureau of Statistics classification (Castles, 1986); the higher of mother's or father's number of years of education, and whether the student was in receipt of the Educational Maintenance Allowance (as a broad indicator of family income). *Non-English Speaking Background* was measured as a weighted composite of each student's mother's and father's country of birth, and language(s) spoken at home.

Student achievement

The *English* and *Mathematics* achievements of students were recorded by teachers using the English Profiles (Victoria, 1991) and the Mathematics Profiles (Victoria, 1992). Both the English and Mathematics Profiles are inventories consisting of multiple indicators describing observable learning behaviours that have been empirically calibrated on a common measurement scale and mapped onto a linear developmental growth continuum called "bands" (English) or "levels" (Mathematics) using the "partial credit model" of item response methodology (Adams & Khoo, 1992; Masters, 1982). For detailed accounts of the development of such profiles, see Griffin (1990), Griffin & Nix (1991) and Rowe (1992). For a brief account of the related technical details for item response methodology see Appendix 5.

These profiles have been validated against widely used criterion/domain-referenced tests and have been shown to have high levels of face-validity, internal consistency and inter-rater reliability. Such profiles have a particular advantage in a study of the present kind since they:

- provide a means of recording student achievement from the full range of both formal methods of assessment (tests and related assessment tasks) and informal methods (observations and descriptive judgements), typically used by teachers, and
- allow meaningful comparisons to be made across the years of schooling and over time.

Teachers rated each student's level of achievement against the indicators in each of the nine Bands (A - I) of the *Reading, Writing* and *Spoken Language* profiles and in each of the twelve Levels (1 - 12) of the *Number* and *Space* profiles. Teachers were asked to indicate a '3' if all of the behaviours associated with a given band/level were consistently displayed by the student, '2' if most of the behaviours were present, '1' if some of the behaviours were beginning to be developed, and '0' if none of the behaviours had been observed. These ratings for each band/level were then added together to give a total score out of 27 for each of the English profiles, or 36 for both Mathematics profiles. A weighted composite score was then constructed for *English achievement* using the *Reading, Writing* and *Spoken Language* profile scores and *Mathematics achievement* using the *Number* and *Space* profile scores.

Student behaviour

Three dimensions of student behaviour were measured, namely *Sociable/Anti-Social, Attentive/Inattentive* and *Settled/Restless*, using an instrument developed by Rowe and Rowe (1989). While both parent and teacher ratings were obtained, only those of teachers have been used in the analyses contained in this report.

Student attitudes

Students were asked to indicate their attitudes towards English and mathematics on three items: (1) "Do you like reading?", (2) "Do you like writing?", and (3) "Do you like maths?" - each measured on 5-point ordinal scales ranging from "Not at all" to "Very much". A weighted composite for *Attitudes to Learning* was computed from students' responses on these items. Students' perceptions of the "Quality of School Life" were obtained from responses to a 14-item inventory adapted from instruments developed by Ainley, Reed & Miller (1986) and Ainley, Goldman & Reed (1990) that built upon the scales developed earlier by Williams & Batten (1981). Weighted composite scores on four scales were obtained, namely, *Liking for School, Social Acceptance* (by peers), *Teacher Responsiveness* and *Curriculum Usefulness.*

Homework

On six items, students indicated the frequency with which they undertake homework in English, mathematics and other subjects - each measured on 5-point ordinal scales ranging from "Every day", "2-3 times per week", "Once per week", "2-3 times per month or Sometimes", and "Never". Weighted composites for *English Homework* and *Maths Homework* were computed.

Parent responses

On a *Parent Questionnaire*, parent(s)/guardian(s) provided data for measures in six major areas: (1) family socio-educational background factors (see above); (2) estimates of the amount of time students spend on school-related and extra-curricula activities per week; (3) the source and frequency of help given to students with regard to homework; (4) the type and frequency of participation in school activities related to curriculum assistance (*Assisting with Class Activities*), attendance at both parent-teacher interviews and information evenings (*Attendance at Parent-Teacher Interviews, etc.*), and school administration (*Involvement in Decision-Making*), (5) an evaluation of the school in terms of the quality of information received on students' educational progress and the perceived extent to which the school meets the educational need of their child (*Parent Perceptions of the School*) and, finally, (6) a rating of their child's behaviour at home, using the same instrument as that completed by teachers (see above).

Teacher affect

Measures were obtained from responses on a semantic differential instrument consisting of 34 seven-point evaluative scales. This instrument was adapted from the Professional Self-Perception Questionnaire (PSPQ), originally developed by Elsworth & Coulter (1977) and modified by Rowe & Sykes (1989). Two scales from the PSPQ were used in this study, namely, *Energy/Enthusiasm* and *Warmth* towards students.

Teachers' perceptions of their work environment

Work environment measures were derived from teachers' responses on the School Organisational Health Questionnaire developed by Hart, Conn & Carter (1992). This 54-item instrument was specifically developed by the Department of School Education (Victoria) to obtain valid and reliable measures of 12 related domains of 'school organisational health', namely: *Morale, Student Orientation, Feedback, Work Demands, Discipline Policy, Leadership (administrative) Support, Peer Support, Role Clarity, Curriculum Co-ordination, Professional Development, Goal Congruence* and *Decision Making*.

The size and nature of the sample design allow accurate estimates of distributions to be reported for each of the key variables of interest. These are a valuable outcome of the study in their own right, as they provide a detailed description of students and teachers in Victorian schools for years Prep, 2, 4, 7 and 9. They also provide a point of reference for the participating schools in reflecting upon their own situation. These results are summarised in Tables 3.1 to 3.7 of Appendix 3.

Student achievement

Table 3.1 summarises achievement levels of students in each of Years Prep, 2, 4, 7 and 9 on each of the three measures of English and the two measures of Mathematics. These data are also summarised graphically in Figures 2 and 3 by means of 'box and whisker' plots. The shaded boxes in the graphs represent the range of achievement of the middle 50 per cent of students, with the bottom of each box being drawn at the level of students achieving at the 25th percentile, and the top of each box showing the 75th percentile. The star in the middle of each of the boxes represents the level of achievement of students at the 50th percentile. The bottom whisker shows the level of achievement of the 10th percentile, while the top whisker shows the 90th percentile. Lines of best fit have been drawn on each graph for the 10th, 50th and 90th percentiles.

The graphs for the three English profiles indicate a period of rapid growth during the first few years of schooling, coinciding with the period during which young people acquire basic literacy skills. Thereafter, the graphs indicate a consistent rate of growth up to Year 9. It is noticeable, however, that the range of achievement increases markedly over the years of schooling with more than four Band widths separating Year 9 students at the 10th and 90th percentiles.

Of particular concern is the flattening out of the growth trajectory at the 10th percentile, where the graphs indicate a trend of less than one band width of growth between Years 4 to 9. The graphs also provide evidence of a discontinuity between primary and secondary schooling, for reading and spoken language especially, with a dip in the rate of progress of students in the first year (Year 7) of secondary school. This pattern has been observed frequently in previous studies using common measures over primary and secondary schooling.

The graphs shown in Figure 3 for Number and Space indicate steady growth from Years Prep to 9, with little evidence of any flattening out of achievement levels among the bottom end of the distribution. The graphs give the impression of a steeper rate of learning, but this is due to the fact that the mathematics profiles are organised into 12 Levels rather than nine Bands. As with the English profiles, the spread of achievement

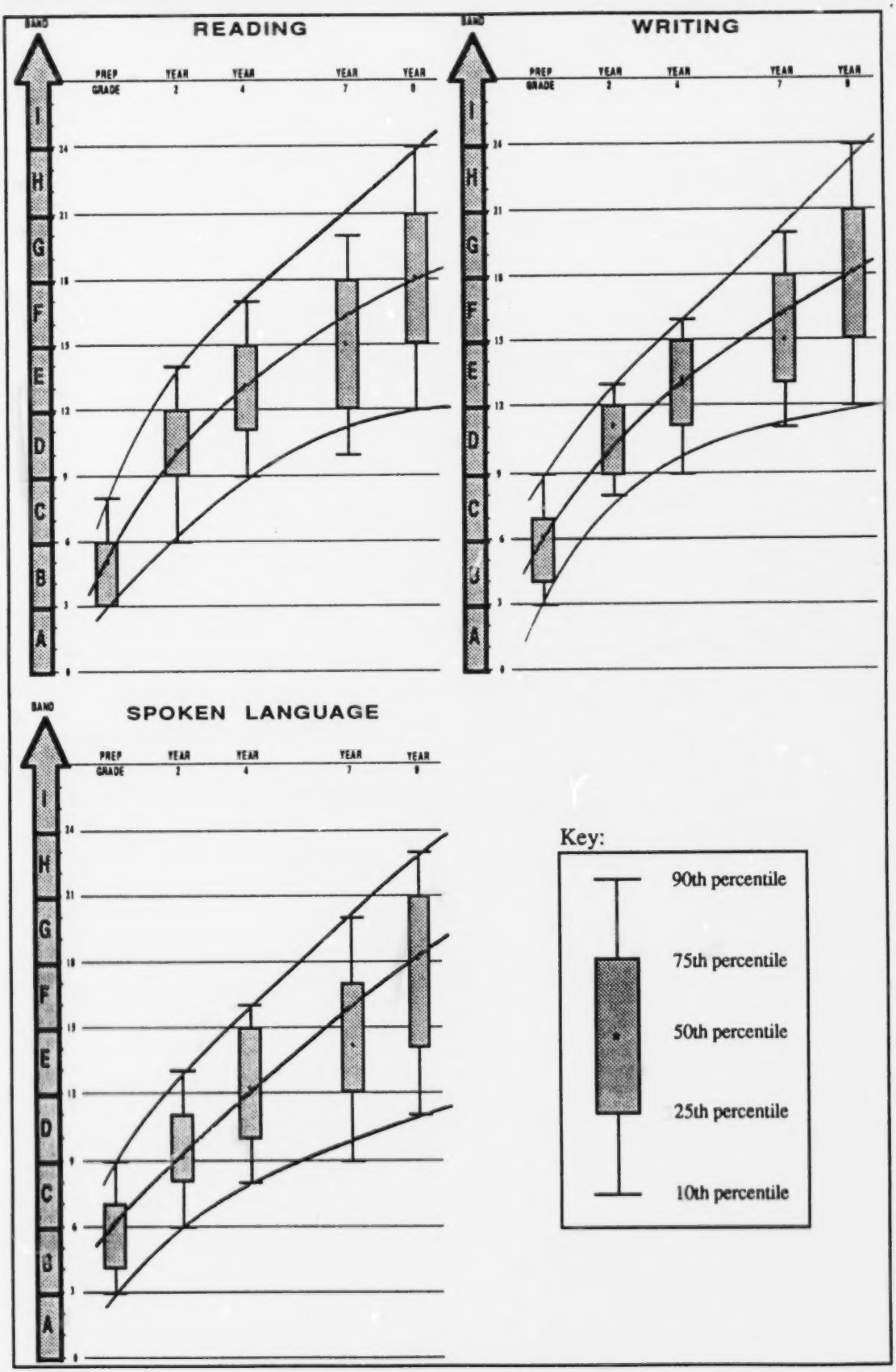
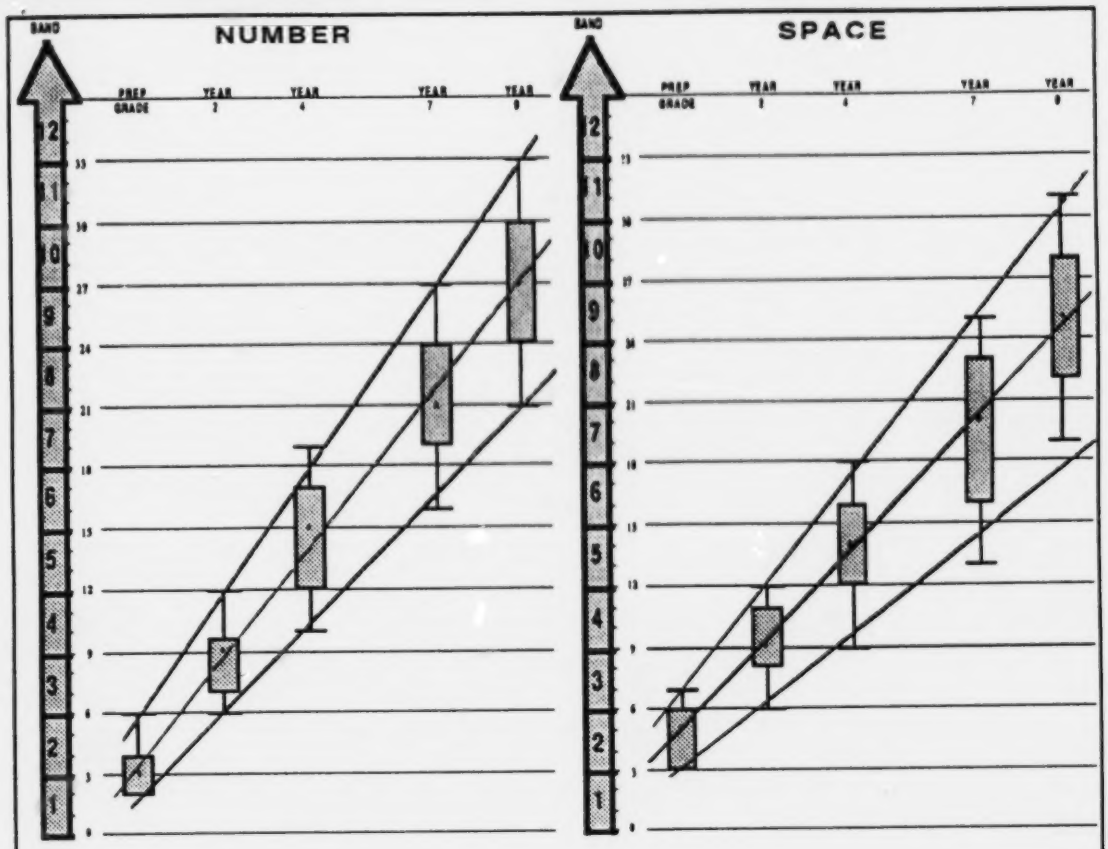


Figure 2. English achievement levels



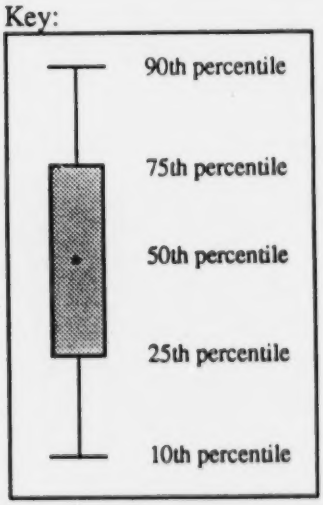


Figure 3. Mathematics achievement levels

increases as students move through the school, with at least four Levels separating students at the 10th and 90th percentiles in Year 9.

For both English and Mathematics, the results as depicted in Figures 2 and 3 are best interpreted by referring back to the detailed set of indicators associated with each Band/Level for each of the profiles. In this way, it is possible to provide a detailed picture of the kinds of abilities possessed by individual students at each Year level, as well as to a criterion- or standards-referenced description of Statewide achievement levels to complement norm-referenced interpretations.

Student behaviour

Table 3.2 gives teachers' ratings of the behaviour of primary and secondary students. These results are summarised in the "box and whisker plots" of Figure 4. The plots reveal a skew to the right-hand or positive side of the bi-polar scales, with teachers recording generally favourable ratings of student behaviours. That is, teachers perceive most of their students to be more sociable than anti-social, more attentive than inattentive and more settled than restless.

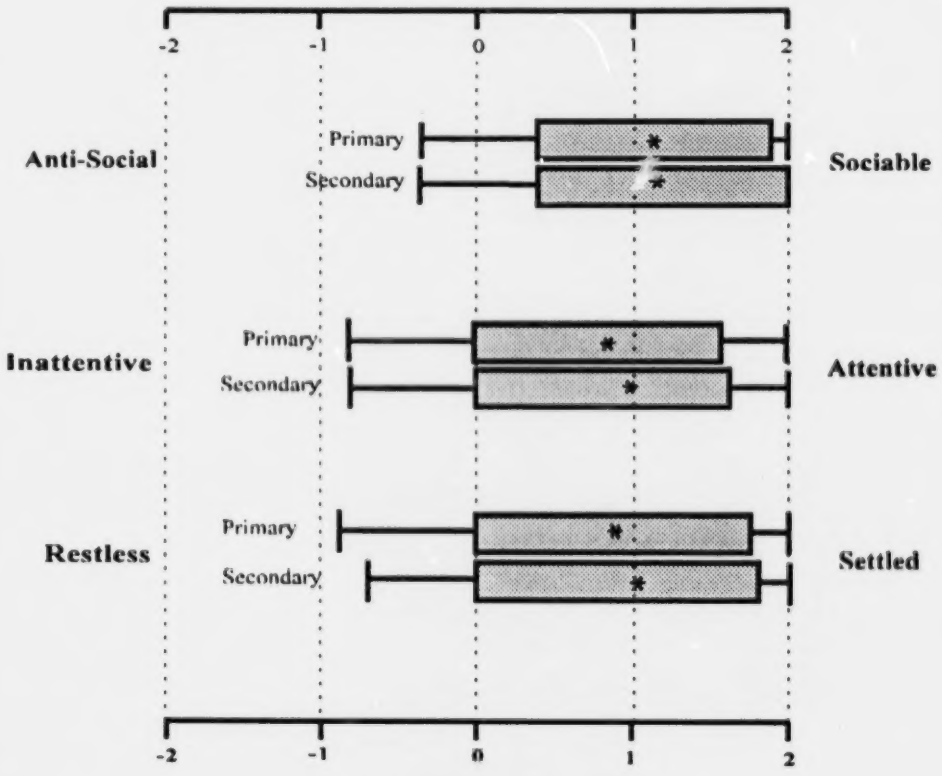


Figure 4. Student behaviour

The whiskers to the left of the plots indicate, however, a tendency for teachers to rate up to 25 per cent of their students towards the inattentive and restless ends of those scales. Somewhat unexpectedly, primary and secondary teachers record similar ratings of their students, despite the generally held perception that negative student behaviour is greater in secondary schools.

Student attitudes

Table 3.3 gives results on various measures of primary and secondary students' perceptions of school life. These results are displayed graphically in Figure 5.

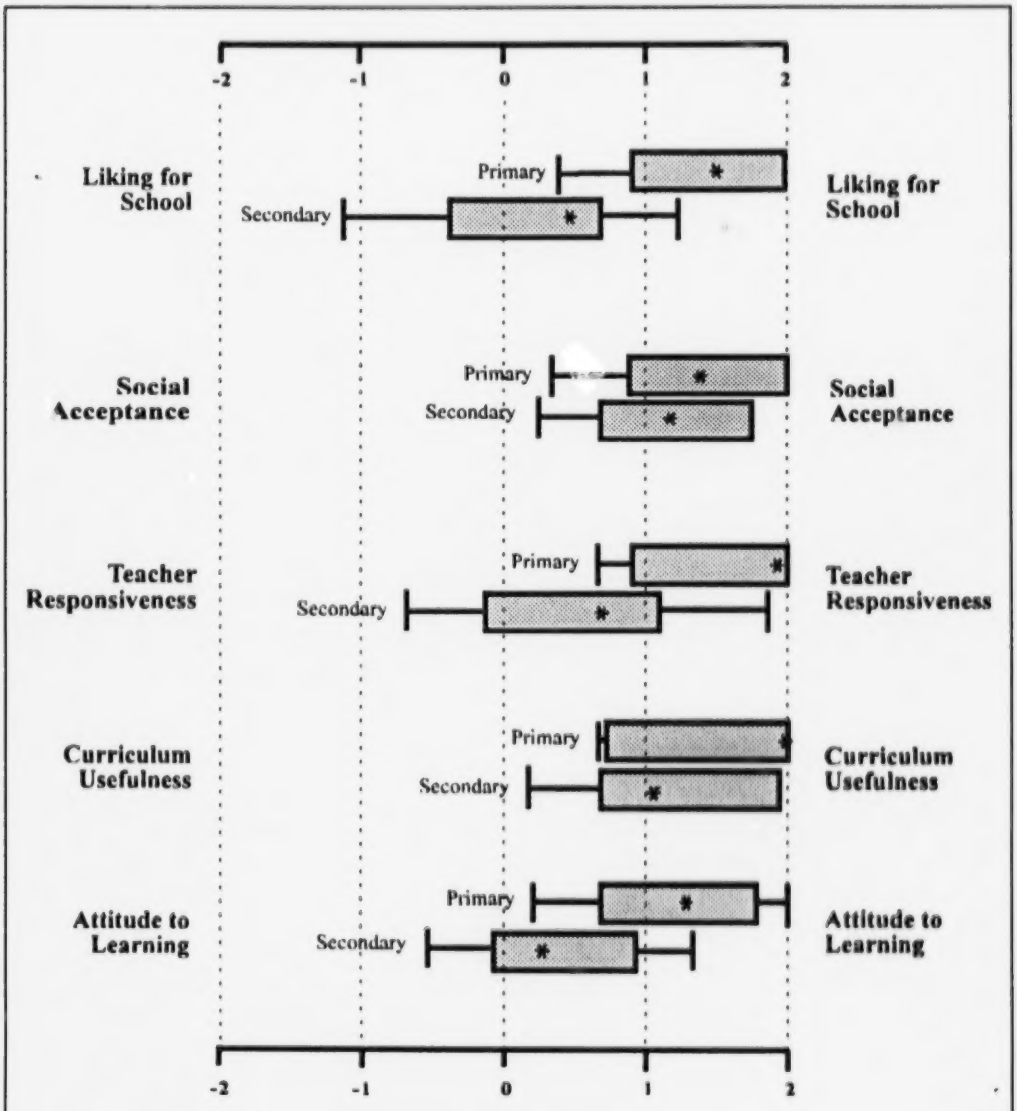


Figure 5. Student attitudes

The most noticeable feature of these data is the strong positive attitudes towards school life among primary school students. The great majority of primary students like school, are accepted socially by their peers, get on well with their teachers, view the curriculum as being useful and relevant and like doing school work.

On the other hand, secondary students, while recording positive responses overall, are less favourably inclined towards their experience of schooling. In particular, there are significant numbers who do not like school and who believe their teachers do not listen to them.

Homework

Table 3.4 sets out results for three measures associated with homework. The first two relate to the frequency of homework done in English and mathematics and the third to the frequency of help received at home from parents, relatives and friends. Once again, these results are shown graphically in Figure 6 for both primary and secondary students.

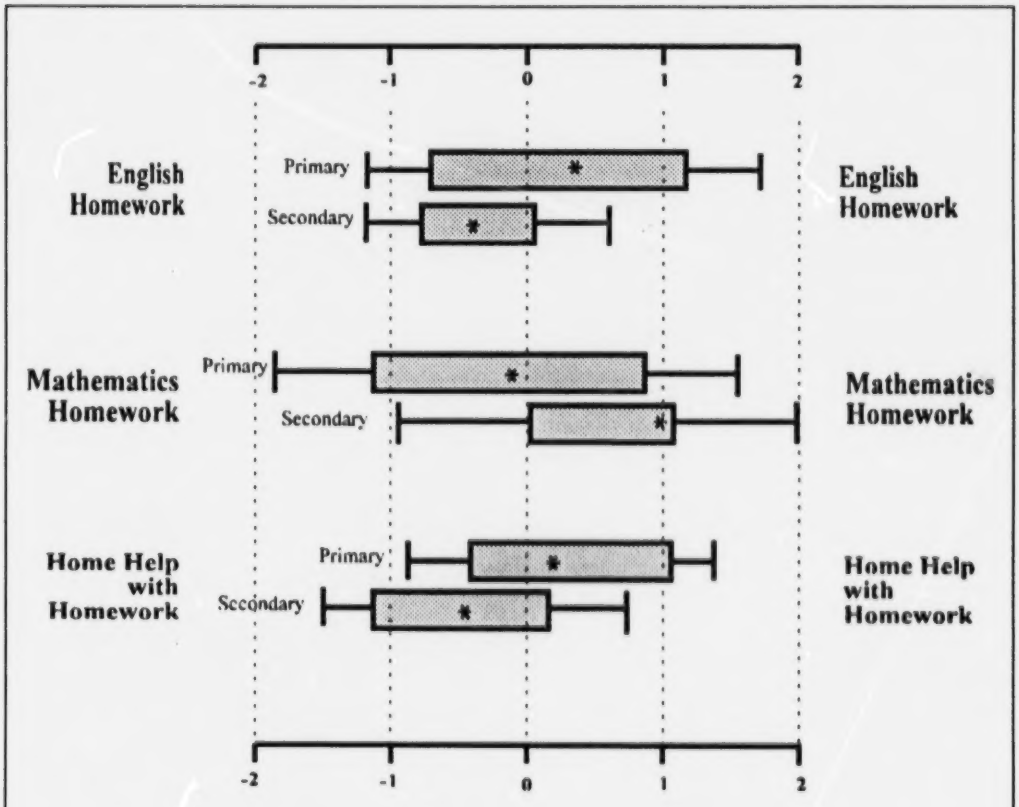


Figure 6. Homework and home help with homework

The "box and whisker" plots indicate great variation in the frequency with which homework is done by primary school students, although it is also evident that primary students frequently receive home help with homework. At the secondary level, the most noticeable feature is the relatively low frequency with which English homework is done compared to the frequency of mathematics homework. At the secondary level, students receive home help less frequently with their homework.

Parent responses

Table 3.5 summarises parent responses to questions regarding their attendance at parent/teacher interviews and information nights, the extent of their involvement in decision-making at the school and parent perceptions of the school and the quality of the education provided. The results are also depicted graphically in Figure 7.

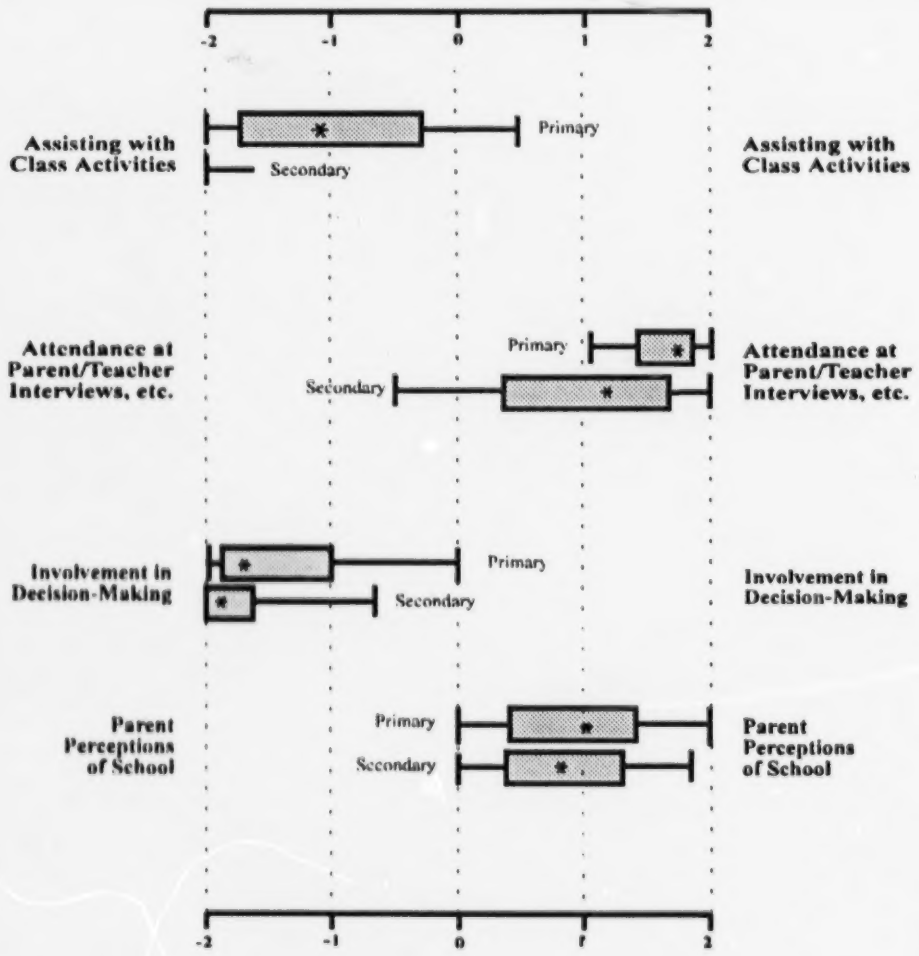


Figure 7. Parent participation and perceptions of the school

The results indicate that assistance with class activities is largely a primary school phenomenon and that parents of primary school children are very regular attenders of meetings at which they receive information on their children's progress, whereas at the secondary level there is a noticeable falling off in attendance at such meetings. Involvement in school-level decision-making is inevitably limited to a few parents, but more are involved at the primary level, perhaps reflecting the greater opportunities in primary school because of their smaller size.

Parents' perceptions of their children's school are generally positive, confirming the commonly observed finding that parents tend to rate highly the school their children attend, whatever their views on schools at large or the system generally.

Teacher affect

Table 3.6 and Figure 8 give results on two measures of teacher affect, namely their energy or enthusiasm and their feelings of warmth towards students. Teachers generally have positive feelings of warmth towards students. However, in regard to their levels of energy or enthusiasm, despite positive ratings overall, there is a wide spread, with significant numbers (≈ 25%) rating themselves at the lower end of the scale.

Teachers' perceptions of their work environment

Table 3.7 presents the results from the measures of teachers' perceptions for 12 aspects of their work environment. These results are also displayed graphically in Figure 9. The "box and whisker" plots reveal that most teachers are generally positive about their work environment. However, they indicate that the majority of teachers receive little feedback on their work performance. Despite the generally positive responses across the range of measures relating to teachers' work environment, there is nonetheless considerable variation among teachers on each of the measures.

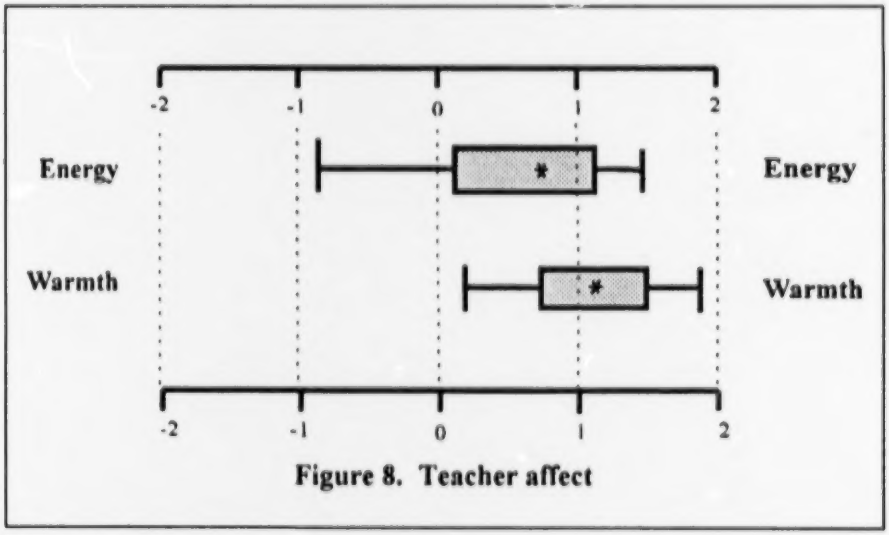


Figure 8. Teacher affect

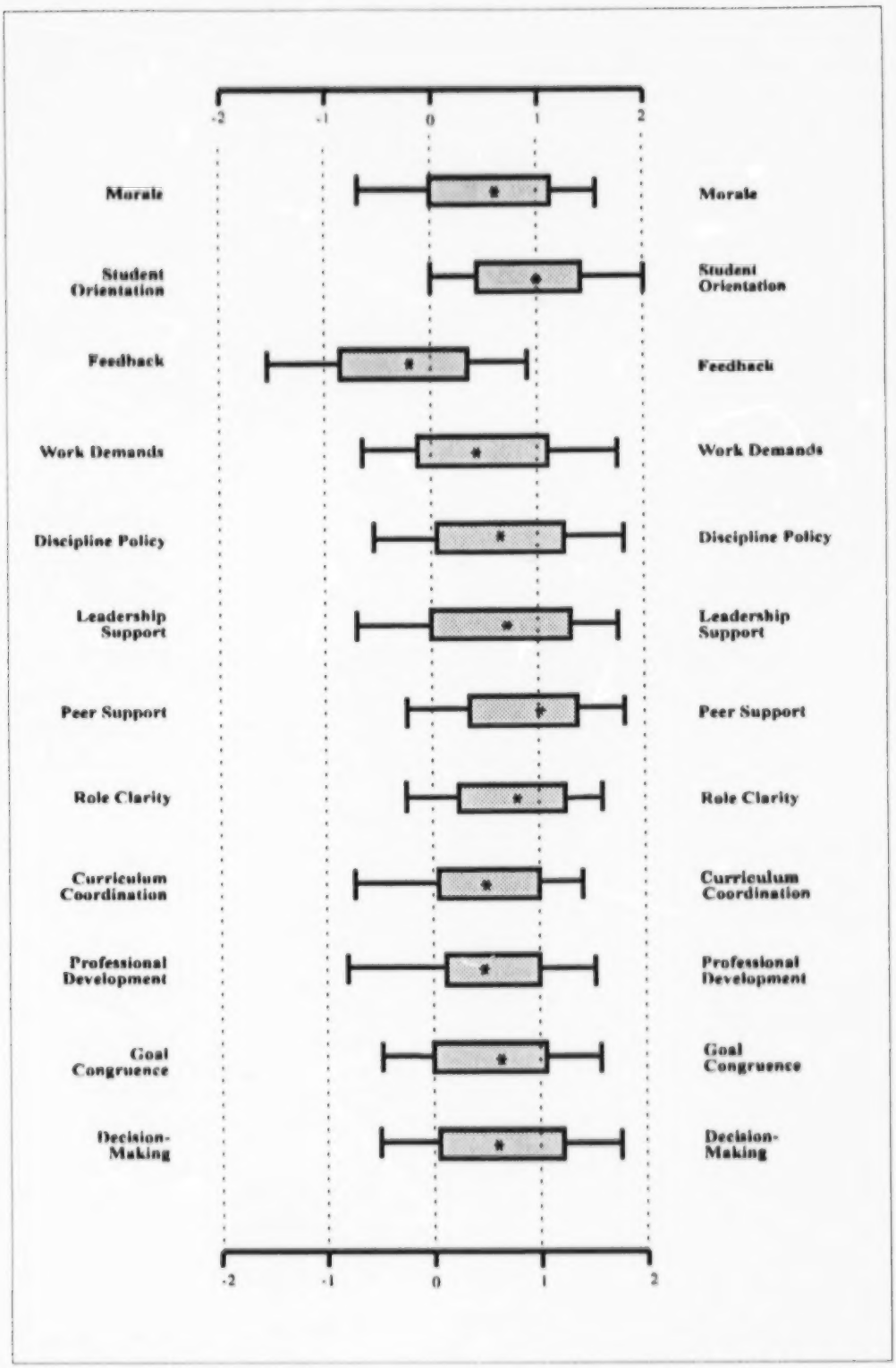


Figure 9. Teachers' perceptions of their work environment

Relationships among student factors

To examine the relationships among factors operating at the student level, structural equation models were fitted to the correlations and covariances among composite scores for each of the student-level variables (see Cuttance & Ecob, 1987). This resulted in a series of four models, two for primary students and two for secondary students, which were judged as providing both good fit to the data and a set of relationships which make substantive sense. These models are summarised in Figures 10 and 11. In these diagrams, each of the arrows represents a statistically significant effect of one factor on another. The thickness of the arrows indicates the relative size of the effects. Tables 4.1 to 4.4 of Appendix 4 provide estimates of the direct, indirect and total standardised path coefficients represented by the diagrams. The related technical notes are provided in Appendix 5.

Primary students

Consider first Figure 10, Tables 4.1 and 4.2, which relate to primary students. The following patterns emerge.

- Student background characteristics appear to have a relatively small effect on achievement levels.
- The effect, either direct or indirect, of the socio-educational level (SEL) of the student's family on English and mathematics achievement is weak, although students from higher SEL levels are more attentive in the classroom and their parents are more likely to attend parent/teacher interviews and information nights.
- Girls have more positive attitudes to learning, are more attentive, and have higher English achievement than boys. The effects of gender on attitudes to learning include substantial indirect effects through attentiveness.
- Students from non-English-speaking backgrounds are more likely to come from lower socio-educational level families and their parents are less likely to attend parent/teacher interviews and information nights.
- Parent participation in parent/teacher interviews and information nights and doing regular homework have positive effects on English achievement and on attitudes to learning.
- Frequent English homework has a positive effect on attitudes to learning.
- Students' perceptions of the usefulness of the curriculum strongly affect their attitudes to learning.
- Attentiveness in the classroom has a positive effect on student attitudes to learning and on their achievement. In the case of English achievement, this effect is massive.

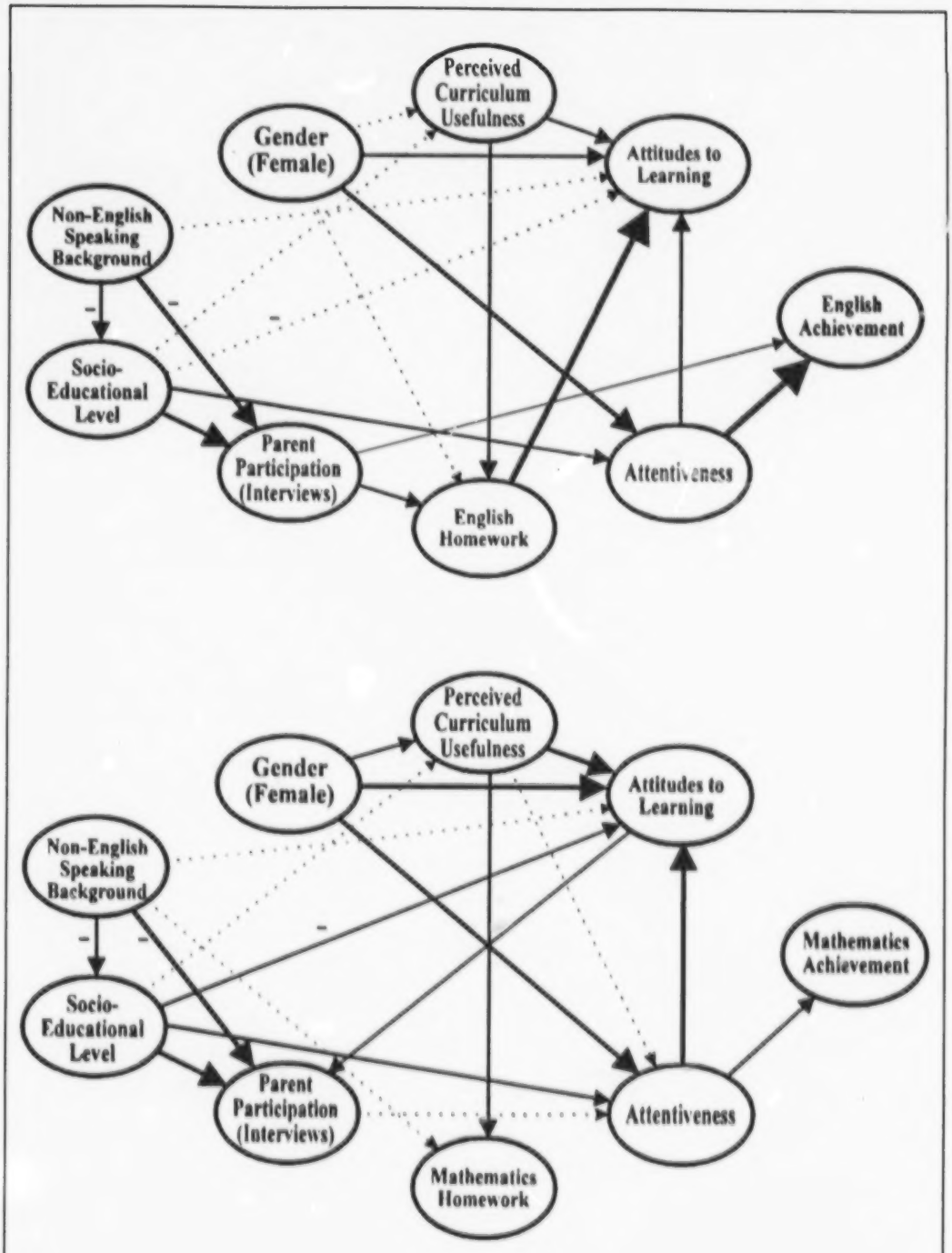


Figure 10. Relationships among factors for primary students

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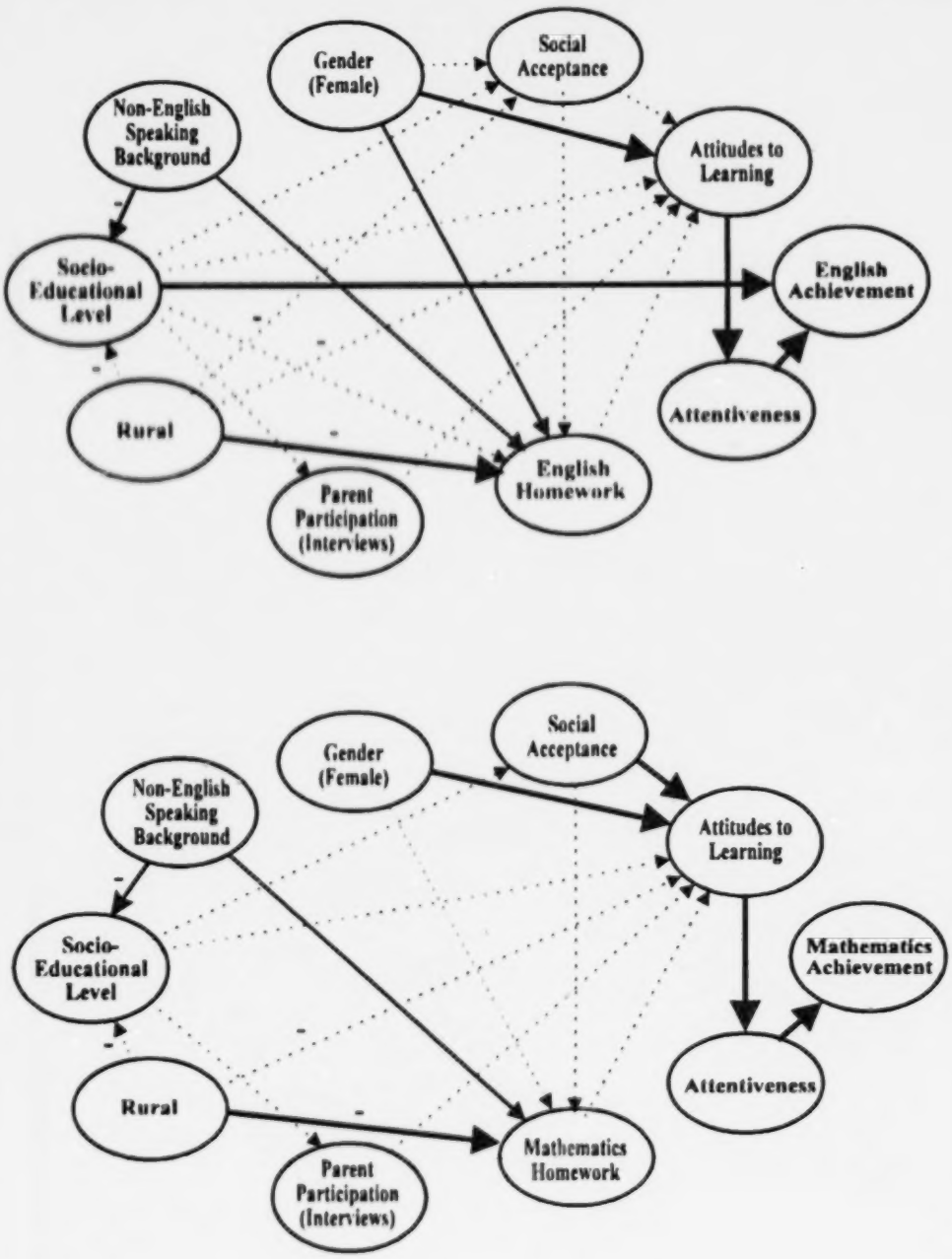

Figure 11. Relationships among factors for secondary students

Secondary students

Tables 4.3 and 4.4 and Figure 11 show the relationships among student-level factors for secondary students, which may be summarised as follows.

- Student background characteristics have an important effect on English achievement, although the effect on mathematics achievement is negligible.
- In particular, the socio-educational level (SEL) of the student's family has a large direct effect on English achievement, as well as much smaller effects on a range of other student-level factors such as parent participation and attitudes to learning.
- Gender (female) is a powerful factor with girls having more positive attitudes to learning, more frequently doing English homework, being more attentive in English classes and achieving higher levels of English.
- Students from non-English-speaking background are more likely to come from families in the lower socio-educational levels, but do homework more frequently.
- Living in a rural location has generally negative effects, especially on homework and attitudes to learning. These effects are notably more marked for English than for mathematics.
- Parent participation in parent/teacher interviews and information nights has a small to negligible effect at the secondary level.
- Students' perceptions of the extent to which they are socially accepted by their peers have a positive effect on their attitudes to learning.
- Students' attitudes to learning have a strong positive effect on their attentiveness and their English achievement.
- Attentiveness in the classroom has a positive effect on achievement and, as with primary students, the effect on English achievement is massive.

Relationships among teacher factors

Figure 12 summarises the relationships among various measures of teachers' perceptions of their work environment, their levels of energy and feelings of warmth towards students. The magnitude of direct, indirect and total effects of key factors are summarised in Table 4.5 of Appendix 4.

Taken together, Figure 12 and Table 4.5 point to the following conclusions.

- Leadership support is overwhelmingly important in establishing a positive working environment for teachers. It is associated with powerful effects on teacher involvement in professional development activities, on teachers' perceptions of the amount of peer support they receive, on the degree of goal congruence among staff within the school, on their involvement in decision-making and on their role clarity.

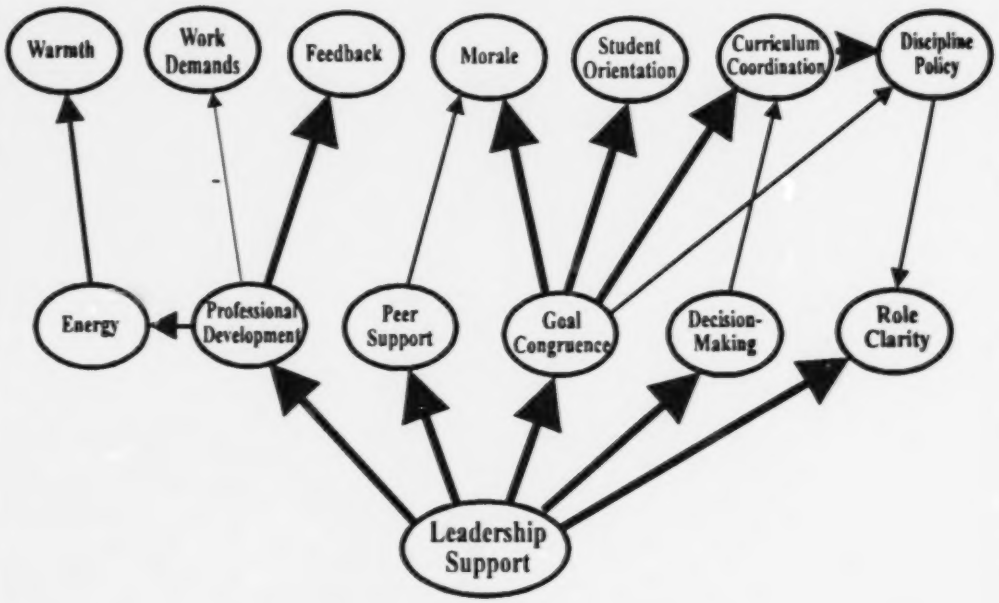

Figure 12. Relationships among teacher factors

- Participation in professional development activities has a positive effect on teachers' levels of energy, which in turn affects their feelings of warmth. It is also associated with positive effects on their perceptions of the amount of feedback they receive. Finally, participation in professional development activities leads to a decline in teachers' perceptions of the work demands placed upon them.

- Teachers' perceptions of the degree of goal congruence within the school have a strong effect on levels of teacher morale, student orientation and curriculum co-ordination within the school, as well as having a considerable effect on teachers' perceptions of the school's discipline policy. There is also a substantial effect of curriculum coordination on the school's discipline policy.

Of the various indicators of the quality of teachers' work environment, considerable interest surrounds that of teacher morale. To ascertain the most important influences on teacher morale, a series of multi-level regression models were fitted to the teacher-level data. The model providing the best explanation for teacher morale is summarised in Figure 13. Standardised regression coefficients and other details of this model are given in Table 4.6, while additional technical information is given in Appendix 5.

The regression analysis indicates that a model which has as explanatory variables each teacher's perceptions of peer support, goal congruence and leadership support, together with the average ratings of leadership support of all teachers in the school, accounts for 73 per cent of the variance in teacher morale. In this model, the predictor exerting the

greatest influence is goal congruence. Leadership support also exerts a strong influence, both as a teacher-level and a school-level predictor.

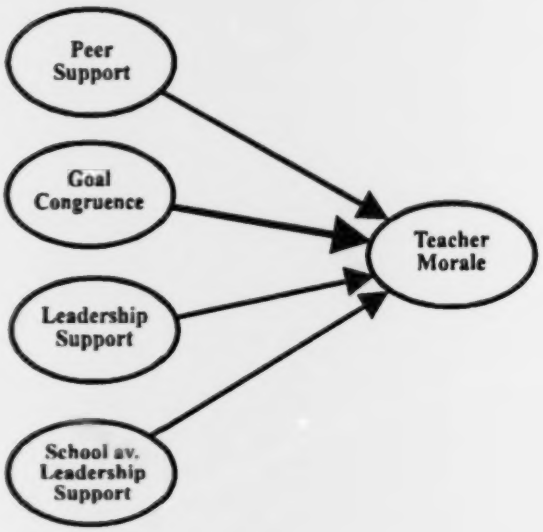

Figure 13. Predictors of teacher morale

The relative importance of school, teacher and student effects

In this research study, the primary aim is to identify the characteristics of schools in which students make rapid and sustained progress in English and Mathematics, after adjusting for their initial levels of achievement. This involves obtaining longitudinal data on achievement in order to compare rates of progress against initial achievement.

At the conclusion of Phase 1 of this study, only a single measure for each of the student achievement outcome measures is available and for this reason the results presented here are necessarily tentative. It is nonetheless possible to obtain a preliminary estimate of the relative importance of school-, class/teacher- and student-level factors by undertaking multi-level analyses using achievement scores adjusted for relevant intake characteristics. As noted earlier, there are problems with this approach since it almost certainly results in serious underadjustments for the effects of intake characteristics. It nevertheless provides a point of comparison with other studies reported in the literature. Tables 4.7 and 4.8 below summarise the results of the multi-level analyses using this approach, while Appendix 5 provides the relevant technical details.

Table 4.7 indicates that when a two-level model is fitted to the achievement data, school-level effects account for between 6.6 and 11.0 per cent of the total variance, or between 7.2 and 11.4 per cent when intake adjusted scores are used. This finding is very much in

line with effect sizes reported in the international research literature. The table also indicates that school effects are generally more significant than intake characteristics, which account for between 3.7 and 8.8 per cent of the variance. The intake characteristics used to adjust students' achievement scores were *gender, socio-educational level, non-English-speaking background* and *rural/non-rural* residential location.

Table 4.7 Per Cent of Variance Explained by Student and School Level Effects: Two-Level Model

Level of Schooling (Outcome)	Unadjusted Scores			Intake Adjusted Scores	
	Intake Effects	Other Student Effects	School Effects	Student Effects	School Effects
Primary (English)	6.1	85.3	8.6	90.8	9.2
Primary (Mathematics)	3.7	85.3	11.0	88.6	11.4
Secondary (English)	8.8	84.6	6.6	92.8	7.2
Secondary (Mathematics)	5.4	86.5	8.1	91.4	8.6

When teacher/class effects are taken into account and a three-level model fitted to the data, a very different picture emerges (see Table 4.8 and Figure 14). School-level effects reduce to an almost negligible 0-3.4 per cent of the total variance, whereas teacher/class effects represent a massive 28-46 per cent. This finding would be of little surprise in situations where schools streamed their students by ability. However, in the Victorian context streaming is almost entirely absent, especially in primary schools, in Government and Catholic secondary schools and in most independent secondary schools. The magnitude of the effects for teacher/class influences thus almost certainly represent the impact of class/ teacher factors rather than effects related to the composition of classes.

Very few comparable studies have been reported in the international literature that have used three-level models to simultaneously examine classroom and school effects on student achievement. A notable exception is a re-analysis of the IEA second mathematics study by Scheerens *et al.* (1989). The results of this re-analysis of mathematics achievement of students in their second year of secondary schooling in nine countries suggests that the Victorian results compare closely to the pattern of results in a number of other countries and are almost identical to those for Finland, New Zealand and Sweeden when results based on intake-adjusted scores are compared. Table 4.9 shows the Victorian secondary mathematics results together with the results for six of the nine countries with a similar pattern of results.

Table 4.8 Per Cent of Variance Explained by Student, Class/Teacher and School Level Effects: Three-Level Model

Level of Schooling (Outcome)	Unadjusted Scores				Intake Adjusted Scores		
	Intake Effects	Other Student Effects	Class/ Teacher Effects	School Effects	Other Student Effects	Class/ Teacher Effects	School Effects
Primary (English)	6.3	58.5	31.2	2.1	64.4	33.3	2.3
Primary (Mathematics)	3.6	51.0	44.0	1.4	52.9	45.6	1.5
Secondary (English)	7.7	63.2	26.0	3.1	68.5	28.1	3.4
Secondary (Mathematics)	4.3	58.6	37.0	0.0	61.3	38.7	0.0

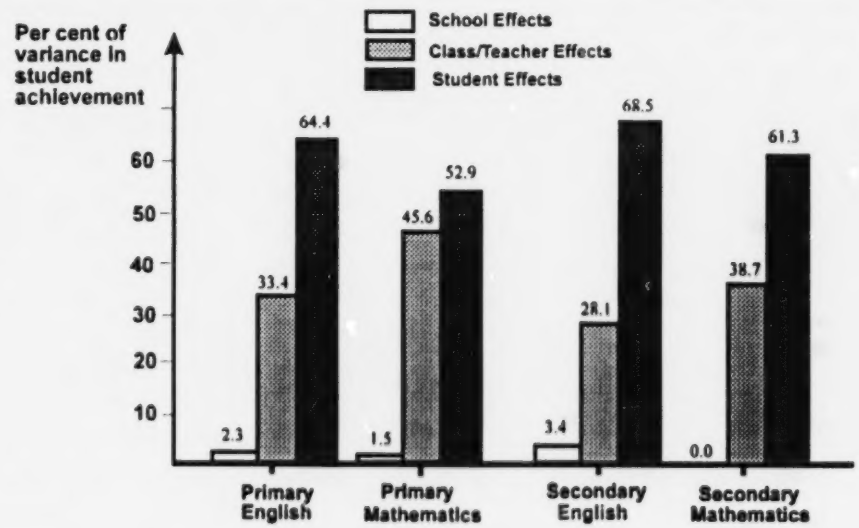

Figure 14. Percentage of variation in students' English and mathematics achievement due to school effects, class/teacher effects and within-student effects

(Note: Variance estimates for achievement have been adjusted for the student-level intake factors of *gender, socio-educational level, Non-English speaking backgound* and *rural* location).

Table 4.9 Per Cent of Variance Explained by Class/Teacher and School Level Effects: Three -Level Model, Seven Countries

Country	Class/Teacher Effects	School Effects
Sweden	45	0
New Zealand	42	0.4
Finland	41	0.2
Victoria (Aust.)	**39**	**0**
Scotland	31	5
Luxembourg	29	15
USA	45	9

Source: Scheerens *et al.*, (1989, p. 794)

In view of the magnitude of teacher effects as they relate to achievement, multi-level analyses were then undertaken of teachers' perceptions of their work environment to ascertain the proportion of variance due to school effects. Results for the measures of teachers' work environment associated with large school effects are summarised in Figure 15. The graph indicates that between-school differences are more marked in primary than in secondary schools, although for both primary and secondary teachers, what school they teach in has a big effect on several aspects of their perceptions of their work environment. For both primary and secondary teachers, between school differences are most marked for teacher morale, with school effects accounting for 33 per cent of the variance of primary teachers' ratings and 31 per cent of secondary teachers' ratings.

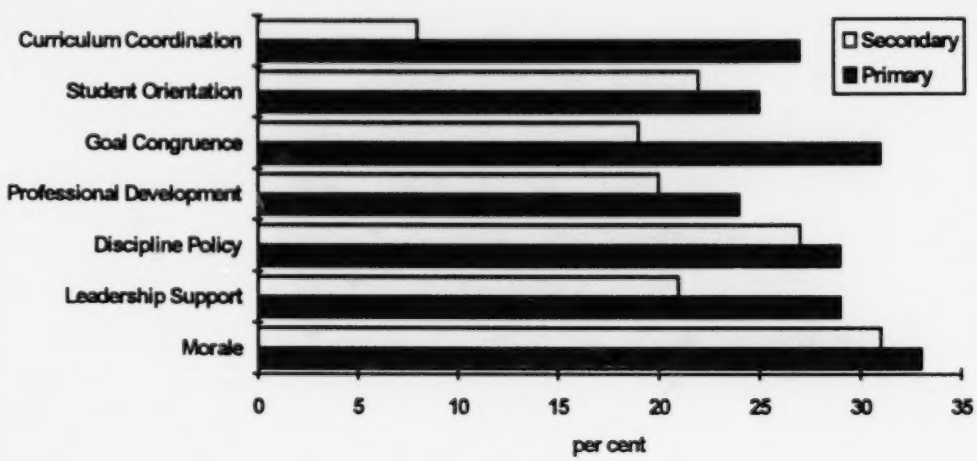

Figure 15. Per cent of variance in teachers' perceptions of their work environment due to school-level effects

KEY FINDINGS FROM PHASE 1

The data from Phase 1 of the project provide a portrait of schooling that is illuminating in its own right, as well as containing vital clues for school improvement and information relevant to policy issues. The following ten key findings have been identified as being of special interest and relevance at the present time.

1. *Profiles provide an effective framework for monitoring and reporting achievement*

An important conclusion which can be drawn from Phase 1 is that the Victorian Profiles function extremely well as a framework for monitoring student progress over Year Prep. to Year 9. This finding is important in the context of national initiatives to develop subject profiles similar to the Victorian Profiles and for school systems as they consider approaches to accountability and school improvement. The performance data obtained indicate clearly what students can typically do at different Year levels and how the level and range of achievement increases over the years of schooling.

At the school level, the indications are that most teachers feel very comfortable using the profiles and with the information they provide. The exception is secondary teachers of mathematics, who are generally less familiar with or less at ease in using the mathematics profiles, and as a consequence, did not always return completed profile assessments of their students. This is not surprising, since at the time of data collection they had received little by way of formal in-service training in their use. This is an issue that needs to be addressed during 1993 for the participating schools and perhaps more broadly.

2. *Schools are not without considerable influence in overcoming inequalities imposed on students by their background characteristics*

The report of the first major empirical study of school effectiveness, *Equality of Educational Opportunity* concluded: "...that schools bring little influence to bear on a child's achievement that is independent of his background and general social context" (Coleman *et al.*, 1966, p. 325). The student-level analyses of the Phase 1 data can be seen as encouraging and confirming one of the key conclusions of recent school effectiveness research, namely that the effects of home background are not as pervasive as was indicated in this early study.

Certainly, home background characteristics have an impact, for example on secondary English achievement, but their effects are often not direct, but mediated through other factors over which schools have a measure of influence, such as attendance at parent/teacher interviews and information nights (in the case of primary English). Some characteristics, such as non-English speaking background, which is often assumed to be

negative in its impact, have positive effects, for example, on attitudes to learning and frequency of homework. In addition, effects can be quite complex. For example, it is evident that intake characteristics such as family socio-educational level, gender and rural location exert a greater influence on English than on mathematics achievement. This indicates that effects can be quite specific within the curriculum.

More work needs to be done on examining the effects of home background characteristics and especially on the compounding effects for those students having membership of more than one educationally disadvantaged group. Such work has relevance for decisions about where to target special needs funding and approaches to the education of students with special needs.

3. The bottom decile of students makes minimal progress in English beyond Year 4

The graphs showing the distribution of achievement for each of Years Prep, 2, 4, 7 and 9, point to the fact that most students make consistent progress over the years of schooling, despite evidence of a slight discontinuity between primary and secondary school. Also, the spread in achievement levels increases the longer students remain in school. The most significant finding, however, is evidence of a trend for the bottom decile of students to make minimal progress in reading and writing between Years 4-9.

This finding highlights the crucial importance of the early childhood years in establishing a firm foundation for learning, especially given the parallel findings regarding the relatively strong effects of home background factors on students' English achievement at the secondary level. One conclusion to be drawn from these results is that they confirm the views of those who advocate placing a high priority on early intervention programs such as *Reading Recovery* which have the potential to place students on a growth trajectory characterised by consistent progress over the years of schooling. Another conclusion is that the later years of schooling are less effective in overcoming any disadvantage relating to student background characteristics.

4. Attentiveness has a massive effect on student achievement

Teachers have generally positive perceptions of the behaviour of students, with negative behaviour being seen as characteristic of a minority of students. However, in the context of fitting explanatory models, it is the attentiveness aspect of behaviour that is the most salient in explaining student achievement. This finding is consistent with a large clinical research literature that shows a strong relationship between students' learning outcomes and their attentive/inattentive behaviours. The other dimensions of behaviour measured in the study, namely sociable/anti-social and settled/restless, are unrelated to other student-level factors and in particular to levels of achievement.

At this stage in the study, it is not possible to say much about the underlying causes of inattentiveness or the extent to which attentiveness can be enhanced by the teacher and the school. There are grounds for believing that in the majority of cases of inattentiveness, psychosocial factors such as anxiety or stress may be the most common explanation while, for a minority, inattentiveness may be related to auditory or other

perceptual problems, or to deeper-seated learning difficulties. These are issues for further investigation during the remaining two phases of the project.

5. *The frequency with which students do homework varies greatly between students; the emphasis on homework changes from primary to secondary school*

At the primary school level, homework has a positive influence on students' attitudes towards learning and to a lesser extent their attentiveness in the classroom and perceptions of the quality of school life. However, the most significant aspect of the data relating to homework is the very different frequencies with which primary and secondary students do homework. Students in primary school appear to do more homework in English than in mathematics, whereas the pattern is reversed for secondary students. In both primary and secondary schools there is enormous variability in the frequency with which students do homework and this applies especially to English homework. These results suggest that for some schools it may be appropriate to review their policies to ensure a more positive and consistent approach to this aspect of the relationship between the home and the school.

6. *Parents' involvement in monitoring their child's education is important for primary students*

The parent response data indicate that there are lower levels of parent participation at the secondary level than at the primary level and that, at both primary and secondary levels, parents have generally positive perceptions of their children's school. These findings are consistent with the related research. In modelling the relationships among student-level factors, it was found that at the primary school level parent involvement in parent/teacher interviews, information nights and other activities connected with monitoring their child's progress has a positive effect on student attitudes, behaviour and learning. This finding is significant in that it suggests school intervention strategies which could increase this kind of participation.

7. *Teachers are generally positive about their work environment, but they receive little feedback on their work performance*

The consistently positive ratings of their work environment by teachers is of interest at a time when it is often asserted that morale is at an all-time low. Teachers completed the teacher questionnaire during Term 3 of 1992, which was generally regarded as a stressful time during a particularly difficult year, especially for the many teachers involved in the process of applying for promotion to the recently-created Advanced Skills Teacher positions. The exception was their ratings of the amount of feedback they receive on their work performance. This suggests that systematic consideration of the whole issue of teacher appraisal is long overdue.

8. *Leadership support is critically important in establishing a positive teacher work environment*

The finding regarding the overwhelming importance of leadership support in establishing a positive work environment accords with the school effectiveness research literature generally. At this stage, however, the study data include only teachers' responses on leadership support. During 1993 it is proposed to introduce a school questionnaire to be completed by the principal and the leadership team, designed to explore perceptions of their personal leadership style, and the issues they confront in exercising leadership, in administering the school and in managing staff. This approach would seem to be especially relevant in view of local initiatives aimed at increasing school autonomy. In the meantime, the finding of large amounts of between-school differences in teacher morale, and the capacity to predict 73 per cent of the variation in teacher morale in terms of leadership support, goal congruence and peer support, suggest that improving the quality of leadership support in the school is the key to positive teacher work environments.

Taken together with the finding regarding the importance of professional development on increasing teachers' energy, warmth and perceptions of feedback, and on decreasing their perceptions of work demands, the teacher response data yielded useful indications of how schools and school systems might usefully direct their efforts to improve teacher quality. Systematic professional development programs for teachers and leadership training programs for principals, vice-principals and senior staff stand out as areas which may demand special priority.

9. *The key to improved educational outcomes is teacher effectiveness*

As observed throughout the report, an ultimate objective of the project is to identify characteristics of schools that are effective given the intake characteristics of their students. At this stage, in the absence of longitudinal data, it is not possible to identify which are the effective schools in the study, nor what their characteristics are. On the basis of intake-adjusted scores, however, one can begin to form some assessment of the relative importance of student, class/teacher and school effects.

Analyses of the Phase 1 data cast new light on the key findings of much previous research and emphasise the importance in studies of school effectiveness that allow class/teacher effects to be taken into account (c.f. Scheerens *et al.*, 1989). In the present study, class/teacher effects were found to be substantial, accounting for between 28.1 to 45.6 per cent of the variance in student achievement.

This finding underscores the fact that learning takes place in classrooms through the interaction of students and their teachers Interpreting these findings requires some care, however, since they have several possible explanations. One is that they reflect streaming of classes. This explanation can almost certainly be discounted since mixed ability classes have for some time been the norm in Victorian schools.

A second explanation is that these results reflect inconsistent use of the profiles by teachers. Here again, there is little evidence in support of this explanation, as the profiles have been demonstrated to have high inter-rater reliability. In addition, efforts

were made to identify and remove from the analyses outlier results submitted by teachers. A very small number of such cases was identified. Nevertheless, this explanation is something to be followed up in phases 2 and 3 of the project by introducing student response measures of achievement to validate teacher assessments using the profiles.

A possible third explanation, namely that the finding of large class/teacher effects and small to insignificant school effects over and above those attributable to teachers, is a reflection of variations in teacher quality. This explanation fits with the findings of a study of Victorian primary schools by Ainley, Goldman & Reid (1990), which found that differences among teachers within schools were greater than differences among schools in the growth they achieved in their students. It suggests that it is primarily through the quality of teaching that effective schools make a difference. Clearly, this hypothesis will be a major focus of the remaining phases of the project.

10. Schools find data obtained through participation in the project to be useful in the context of school improvement

One of the aims of the Victorian Quality Schools Project has been to facilitate school improvement processes within participating schools. To this end, at the 22 separate meetings with staff from participating schools, attention has been devoted to exploring ways in which each school's results might be used both in the context of traditional approaches to school improvement and more modern approaches to quality assurance and total quality management. In particular, emphasis has been placed on exploring the relevance of the information provided as a result of participation in the project with an approach to quality assurance that emphasises continuous improvement of processes and outcomes, understanding the reasons for variation, measurement of processes and basing decisions on facts and data, and establishing a client orientation.

The overwhelming reaction from schools is that they value highly feedback on their own school's pattern of results. In many instances it provides data of a kind that the school has not had access to in the past and provide new insights or confirmations of trends that have been suspected but not confirmed. Staff from the participating schools also respond positively to the overall findings of the project and are interested in relating their own results to these findings.

Considerable emphasis has also been placed on the need to handle school results with great sensitivity and due consideration of the need to protect the anonymity of individuals. The dangers of misinterpreting results has likewise been stressed and alternative explanations are explored to sensitise staff to the range of valid interpretations for a particular result.

The longitudinal nature of the project means that there is an opportunity to monitor the impact of involvement in the project on school improvement processes within the participating schools.

Towards a model of school and teacher effectiveness

While the literature on school effectiveness contains a number of 'recipe' style lists of characteristics of effective schools (e.g., Edmonds, 1981; Levine & Lezotte, 1990; Purkey & Smith, 1983), there are fewer instances of attempts to place empirical findings within a theoretical framework that shows the relationships among key factors. Some notable exceptions include models proposed by Banks (1992), Coleman & Collinge (1991), Cuttance (1992), Mortimore (1992), Reynolds, Hopkins & Stoll (1993) and the research agenda proposed by Scheerens (1993). The findings of this study add significantly to the available empirical evidence. The final section of this report attempts to bring together ideas and evidence in the literature with the present findings to propose a tentative model of teacher and school effectiveness that will be tested and refined during the remaining phases of the study.

At this stage, it is suggested that any attempt to embrace both school and teacher effectiveness in a single theoretical model will have the following characteristics:

- It must be a highly generalised model to accommodate the range of relevant factors
- It must reflect the organisational characteristics of schools and the hierarchical clustering of students within teaching groups, within schools
- It must allow for complex interrelationships at each level of factors, as well as between levels.
- It must be dynamic and reflect the fact that learning takes place over time within a context that is constantly and often dramatically changing.

Given these characteristics, the model summarised in Figure 16 is offered as a heuristic of school and teacher effectiveness. An essential feature of the model is the recognition of the importance of student *readiness* or *availability* for school learning (Rutter, 1985). Major elements of this availability include functional levels of *attentiveness* and positive *attitudes* towards learning. These elements are influenced, both directly and indirectly by a stable and supportive psychosocial home environment and by parent participation and interest in monitoring their child's educational progress. They are also influenced by short-term critical events, including illness, absence from school, and a range of family and personal trauma events, which can include family breakup, loss of employment, death or illness of close relatives, and so on (Wallerstein, 1991). The other key factors influencing readiness and availability for learning are positive teacher affect (Ashton & Webb, 1986), teachers' positive perceptions of their work environment and, of course, the quality of teaching. School organisation and leadership support are vitally important in establishing a context for positive teachers' perceptions of their work environment. The dynamic aspect of the model is indicated by its conception of student learning outcomes as being represented by the rate and consistency of progress made by students.

It will be noted that at this stage, the present study provides little or no evidence regarding the effects, both direct and mediated, of critical events affecting students or of the quality of teaching. These are factors to be incorporated into phases 2 and 3 of the study that will now be shaped in order to test the validity, reliability and stability of this

model, to elucidate the conditions and extent to which students, parents, teachers and schools *make a difference*, and provide practical strategies for school and teacher improvement designed to maximise and sustain student growth.

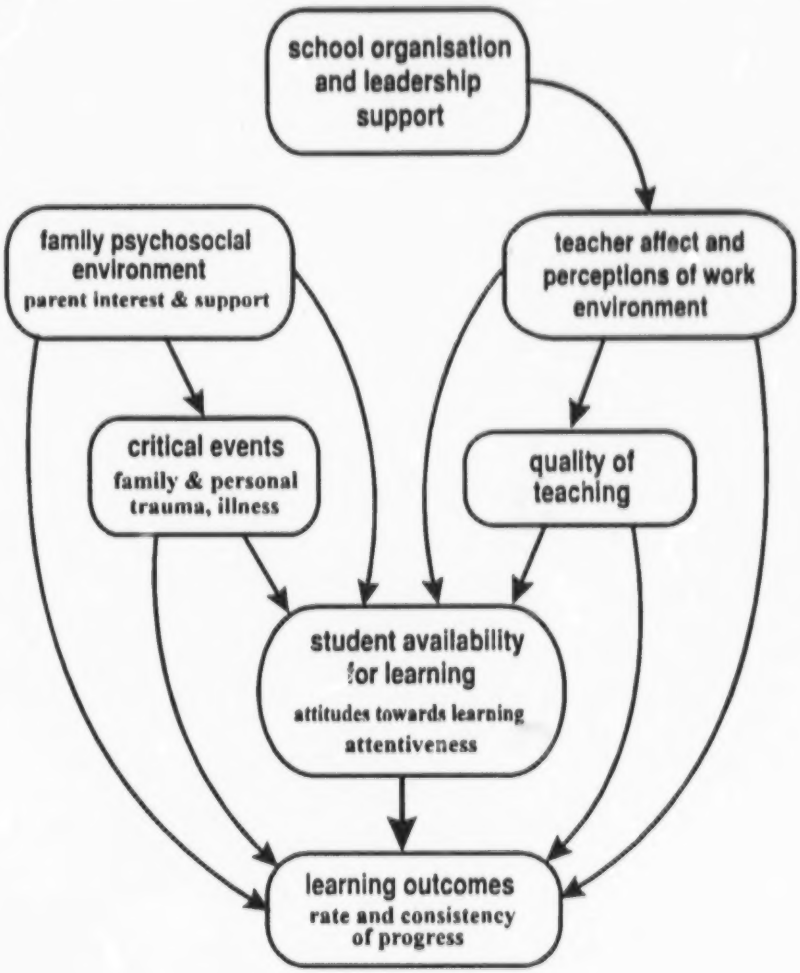

Figure 16. A heuristic model of school and teacher effectiveness

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ACHIEVED SAMPLE

Table 1.1 Student Sample, 1992

Year Level	Government	Catholic	Independent	Total
Prep	1719	421	141	2281
Year 2	1656	389	143	2188
Year 4	1651	402	156	2209
Primary	*5026*	*1212*	*440*	*6678*
Year 7	2624	389	648	3661
Year 9	2576	391	603	3570
Secondary	*5200*	*780*	*1251*	*7231*
Total	**10226**	**1992**	**1691**	**13909**

Table 1.2 Teacher Sample, 1992

School Type	Government	Catholic	Independent	Total
Primary	277	69	19	365
Secondary	454	39	8	538
P-12	-	-	65	65
Total	**731**	**108**	**92**	**931**

Table 1.3 School Sample: 1992*

School Type	Government	Catholic	Independent	Total
Primary	41	12	6	59
Secondary	22	3	6	31

* It is not appropriate to add together the numbers of primary and secondary schools since some are the same school, or campuses of the same school.

MEASUREMENT OF VARIABLES

Table 2.1 Measurement of Student-Level Variables

Variable	Number of Items	Reliability* Prim.	Reliability* Sec.	Description or Sample Item(s)
Student Background				
Socio-Educational Level	3	0.908	0.908	Based mainly on parent's occupation status but includes parent's level of education and an income measure.
Non-English Speaking Background	4	0.969	0.974	Based on whether or not the student, mother and/or father was born in a non-English speaking country and whether or not English is mainly spoken at home.
Rural/Non-rural	1	1.000	1.000	Based on whether or not the student resides in a city of more than 25,000 people.
Student Achievement				
English	3	0.961	0.931	Based on the Victorian English Profiles (reading, writing and spoken language).
Mathematics	2	0.966	0.900	Based on the Victorian Mathematics Profiles (number and space).
Student Behaviour				
Anti-Social/Social	4	0.939	0.931	Can't control behaviour ... Controls behaviour
				Irritable,'touchy' ... Even tempered
Inattentive/Attentive	4	0.946	0.957	Easily frustrated ... Persistent
				Aimless activity ... Purposeful activity
Restless/Settled	3	0.926	0.938	Restless ... Relaxed
				On the go, lively ... Settled, calm
Student Attitudes				
Liking for School	4	0.889	0.915	My school is a place where I get enjoyment from being there.
Social Acceptance	3	0.770	0.790	My school is a place where I get on well with other students in my class.

Table 2.1 (cont.) Measurement of Student-Level Variables

Variable	Number of Items	Reliability* Prim.	Reliability* Sec.	Description or Sample Item(s)
Teacher Responsiveness	3	0.842	0.807	My school is a place where my teachers listen to what I say.
Curriculum Usefulness	3	0.962	0.894	My school is a place where what I learn will be useful.
Attitude to Learning	4	0.672	0.673	I like reading; I like writing; I like maths.
Homework and Home Help				
English Homework	4	0.699	0.753	I read books to my family every day; I talk with my family about books I have read every day.
Mathematics Homework	2	0.832	0.919	I do Maths homework every day.
Home Help with Homework	3	0.593	0.702	Mother/Father, how often do you help your child with homework.
Parent Responses				
Assisting with Class Activities	5	0.837	0.921	I/we read to, or listen to students read at school; I/we assist teachers in the classroom.
Attendance at Parent/Teacher Interviews, etc.	3	0.771	0.842	I/we attend parent-teacher interviews about our child's progress.
Involvement in Decision-Making	4	0.901	0.920	I/we contribute to decision-making on school administration and finance.
Parent Perceptions of the School	3	0.864	0.854	The school provides quality information about the educational progress of children; The school is meeting the educational needs of children.

* Scale reliability indices are calculated from the maximally weighted factor score regression coefficients obtained from the related one-factor congeneric models. For further details see Appendix 5.

Table 2.2 Measurement of Teacher-Level Variables

Variable	Number of Items	Reliability*	Description or Sample Item(s)
Teacher Affect			
Energy/Enthusiasm	5	0.915	Unenthusiastic ..... Enthusistic Inert ..... Energetic
Warmth	5	0.895	Hostile ..... Friendly Reproaching ..... Comforting
Teacher Work Environment			
Morale	4	0.882	The morale in this school is high.
Student Orientation	3	0.830	This school promotes the concept of students being individuals.
Feedback	6	0.934	There is a structure and ongoing process that provides feedback on my work performance.
Work Demands	4	0.839	Teachers are overloaded with work in this school.
Discipline Policy	4	0.871	The rules and sanctions relating to discipline in this school are well understood by teachers and students.
Leadership Support	5	0.937	There is support from the administration in this school.
Peer Support	5	0.924	I receive support from my colleagues.
Role Clarity	4	0.806	I am always clear about what others at school expect of me.
Curriculum Coordination	3	0.808	There is effective coordination of the curriculum in this school
Professional Development	5	0.882	I am encouraged to pursue further professional development.
Goal Congruence	5	0.873	My personal goals are in agreement with the goals of this school.
Decision-Making	4	0.849	There is opportunity for staff to participate in school policy and decision-making.

* Scale reliability indices are calculated from the maximally weighted factor score regression coefficients obtained from the related one-factor congeneric models. For further details see Appendix 5.

RESULTS FROM PHASE 1

Table 3.1 Student Achievement

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Limits
English								
Reading								
Prep	3	3	5	6	8	5.19	2.19	± 0.095
Yr. 2	6	9	10	12	14	10.01	2.76	± 0.122
Yr. 4	9	11	13	15	17	12.85	3.10	± 0.138
Yr. 7	10	12	15	18	20	15.06	3.88	± 0.144
Yr. 9	12	15	18	21	24	17.67	4.72	± 0.171
Writing								
Prep	3	4	6	7	9	5.77	2.22	± 0.097
Yr. 2	8	9	11	12	13	10.32	2.32	± 0.103
Yr. 4	9	11	13	15	16	12.82	2.98	± 0.132
Yr. 7	11	13	15	18	20	15.53	3.77	± 0.140
Yr. 9	12	15	18	21	24	18.10	4.34	± 0.157
Oral								
Prep	3	4	6	7	9	5.53	2.32	± 0.101
Yr. 2	6	8	9	11	13	9.61	2.69	± 0.119
Yr. 4	8	10	12	15	16	12.27	3.17	± 0.141
Yr. 7	9	12	14	17	20	14.24	4.13	± 0.153
Yr. 9	11	14	18	21	23	17.21	4.87	± 0.177
Mathematics								
Number								
Prep	2	2	3	4	6	3.43	1.55	± 0.067
Yr. 2	6	7	9	10	12	8.81	2.37	± 0.106
Yr. 4	10	12	15	17	19	14.68	3.52	± 0.157
Yr. 7	16	19	21	24	27	21.58	4.38	± 0.172
Yr. 9	21	24	27	30	33	27.13	4.61	± 0.184
Space								
Prep	3	3	5	6	7	4.92	1.80	± 0.078
Yr. 2	6	8	9	11	12	9.12	2.36	± 0.106
Yr. 4	9	12	14	16	18	14.04	3.43	± 0.153
Yr. 7	13	16	20	23	25	19.40	4.66	± 0.183
Yr. 9	19	22	25	28	31	24.77	4.82	± 0.193

Table 3.2 Student Behaviour

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
Anti-Social/ Social								
Primary	- 0.35	0.40	1.15	1.86	2.00	1.01	0.93	± 0.023
Secondary	- 0.36	0.40	1.15	2.00	2.00	1.01	0.98	± 0.023
Inattentive/ Attentive								
Primary	- 0.84	0.00	0.89	1.59	2.00	0.68	1.08	± 0.026
Secondary	- 0.82	0.00	0.99	1.62	2.00	0.69	1.09	± 0.026
Restless/ Settled								
Primary	- 0.90	0.00	0.90	1.79	2.00	0.68	1.12	± 0.028
Secondary	- 0.69	0.00	1.00	1.84	2.00	0.79	1.08	± 0.026

Table 3.3 Student Attitudes

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
Liking for School								
Primary	0.40	0.91	1.50	2.00	2.00	1.32	0.77	± 0.019
Secondary	- 1.14	- 039	0.47	0.67	1.23	0.17	0.91	± 0.022
Social Acceptance								
Primary	0.34	0.89	1.38	2.00	2.00	1.28	0.73	± 0.018
Secondary	0.27	0.67	1.16	1.73	1.73	1.04	0.70	± 0.017
Teacher Responsiveness								
Primary	0.67	0.88	1.91	2.00	2.00	1.48	0.72	± 0.018
Secondary	- 0.69	- 0.11	0.67	1.10	1.88	0.56	0.93	± 0.022
Curriculum Usefulness								
Primary	0.67	0.73	1.98	2.00	2.00	1.54	0.76	± 0.019
Secondary	0.18	0.67	1.09	1.94	1.94	1.12	0.84	± 0.020
Attitudes to Learning								
Primary	0.22	0.69	1.28	1.78	2.00	1.14	0.69	± 0.017
Secondary	- 0.53	- 0.08	0.44	0.94	1.34	0.42	0.74	± 0.018

Table 3.4 Homework and Home Help

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
English Homework								
Primary	- 1.20	- 0.72	0.36	1.17	1.72	0.24	1.09	± 0.027
Secondary	- 1.17	- 0.80	- 0.39	0.08	0.61	- 0.34	0.69	± 0.016
Mathematics Homework								
Primary	- 1.89	- 1.11	- 0.11	0.89	1.67	- 0.20	1.26	± 0.035
Secondary	- 0.94	0.03	0.97	1.03	1.97	0.75	0.96	± 0.024
Home Help with Homework								
Primary	- 0.90	- 0.40	0.19	1.06	1.38	0.28	0.92	± 0.027
Secondary	- 1.49	- 1.12	- 0.46	0.15	0.75	- 0.41	0.83	± 0.028

Table 3.5 Parent Participation and Perceptions of the School

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
Assisting with Class Activities								
Primary	- 2.00	- 1.75	- 1.11	- 0.28	0.42	- 0.94	0.93	± 0.025
Secondary	- 2.00	- 2.00	- 2.00	- 1.71	- 1.17	- 1.74	0.51	± 0.015
Attendance at Parent/Teacher Interviews, etc.								
Primary	1.06	1.46	1.73	1.87	2.00	1.57	0.57	± 0.015
Secondary	- 0.50	0.39	1.21	1.70	2.00	0.93	0.99	± 0.032
Involvement in Decision-Making								
Primary	- 2.00	- 1.90	- 1.71	- 1.02	0.10	- 1.29	0.93	± 0.025
Secondary	- 2.00	- 1.97	- 1.91	- 1.67	- 0.79	- 1.60	0.78	± 0.023
Parent Perceptions of the School								
Primary	0.00	0.41	1.00	1.41	2.00	0.91	0.71	± 0.019
Secondary	0.00	0.33	0.84	1.33	1.84	0.78	0.73	± 0.021

Table 3.6 Teacher Affect

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
Energy	- 0.88	0.13	0.77	1.20	1.47	0.55	0.86	± 0.060
Warmth	0.23	0.73	1.16	1.52	1.88	1.07	0.64	± 0.047

Table 3.7 Teachers' Perceptions of their Work Environment

Variable	10th %-ile	25th %-ile	50th %-ile	75th %-ile	90th %-ile	Mean	S.D.	95% Confidence Intervals around Mean
Morale	- 0.70	0.00	0.62	1.13	1.55	0.49	0.87	± 0.063
Student Orientation	- 0.02	0.45	1.00	1.41	2.00	0.90	0.74	± 0.052
Feedback	- 1.55	- 0.86	- 0.21	0.36	0.92	- 0.26	0.91	± 0.065
Work Demands	- 0.64	- 0.11	0.45	1.10	1.75	0.46	0.88	± 0.062
Discipline Policy	- 0.53	0.05	0.80	1.25	1.84	0.67	0.87	± 0.061
Leadership Support	- 0.72	0.01	0.71	1.30	1.79	0.60	0.95	± 0.067
Peer Support	- 0.23	0.35	0.97	1.35	1.87	0.83	0.82	± 0.058
Role Clarity	- 0.24	0.25	0.78	1.25	1.59	0.72	0.71	± 0.050
Curriculum Coordination	- 0.79	- 0.08	0.54	1.00	1.42	0.40	0.85	± 0.060
Professional Development	- 0.82	- 0.14	0.45	1.03	1.50	0.38	0.90	± 0.064
Goal Congruence	- 0.51	0.08	0.62	1.07	1.57	0.56	0.78	± 0.055
Decision-Making	- 0.52	0.07	0.61	1.22	1.73	0.60	0.84	± 0.060

RELATIONSHIPS AMONG VARIABLES

Table 4.1 Relationships Among Primary Student Variables (English): Standardised Direct, Indirect and Total Effects

Effects	Direct Effects	Indirect Effects	Total Effects
of Socio-Educational Level			
on			
Parent Partic. (Interviews)	0.247	-	0.247
English Homework	-	0.050	0.050
Attitude to Learning	-.091	0.074	-.017
Perceived Curric. Usefulness	0.077	-	0.077
Attentiveness	0.192	0.006	0.199
English Achievement	-	0.166	0.166
of Non-English-Speaking Background			
on			
Socio-Educational Level	-.148	-	-.148
Parent Partic. (Interviews)	-.223	-.037	-.260
English Homework	-	-.044	-.044
Attitude to Learning	0.060	-.013	0.046
Perceived Curric. Usefulness	-	-.011	-.029
English Achievement	-	-.068	-.068
of Gender (Female)			
on			
English Homework	0.091	0.011	0.102
Attitude to Learning	0.104	0.113	0.217
Perceived Curric. Usefulness	0.092	-	0.092
Attentiveness	0.266	-.008	0.274
English Achievement	-	0.162	0.162
of Parent Participation (Interviews)			
on			
English Homework	0.164	-	0.164
Attitude to Learning	-	0.071	0.071
English Achievement	0.195	-	0.195
of Perceived Curriculum Usefulness			
on			
English Homework	0.121	-	0.121
Attitude to Learning	0.189	0.068	0.257
Attentiveness	0.082	-	0.082
English Achievement	-	0.048	0.048
of English Homework			
on			
Attitude to Learning	0.434	-	0.434
of Attentiveness			
on			
Attitude to Learning	0.189	-	0.189
English Achievement	0.593	-	0.593

Table 4.2 Relationships Among Primary Student Variables (Mathematics): Standardised Direct, Indirect and Total Effects

Effects	Direct Effects	Indirect Effects	Total Effects
of Socio-Educational Level			
on			
Parent Partic. (Interviews)	0.260	-.003	0.257
Mathematics Homework	-	0.011	0.011
Attitude to Learning	-.125	0.094	-.030
Perceived Curric. Usefulness	0.083	-	0.083
Attentiveness	0.176	0.022	0.199
Mathematics Achievement	-	0.039	0.039
of Non-English-Speaking Background			
on			
Socio-Educational Level	-.145	-	-.145
Parent Partic. (Interviews)	-.226	-.031	-.257
Mathematics Homework	0.098	-.002	.096
Attitude to Learning	0.076	-	.076
Perceived Curric. Usefulness	-	-.012	-.012
Attentiveness	-	-.042	-.042
Mathematics Achievement	-	-.008	-.008
of Gender (Female)			
on			
Mathematics Homework	-	0.015	0.015
Attitude to Learning	0.221	0.129	0.350
Perceived Curric. Usefulness	0.112	-	0.112
Attentiveness	0.226	0.051	0.277
Mathematics Achievement	-	0.054	0.054
of Parent Participation (Interviews)			
on			
Attitude to Learning	-	0.019	0.019
Attentiveness	0.062	-	0.062
Mathematics Achievement	-	0.012	0.012
of Attitude to Learning			
on			
Parent Partic. (Interviews)	0.087	-	0.087
Attentiveness	-	0.005	0.005
Mathematics Achievement	-	0.001	0.001
of Perceived Curriculum Usefulness			
on			
Parent Partic. (Interviews)	-	0.036	0.036
Mathematics Homework	0.137	-	0.137
Attitude to Learning	0.388	0.025	0.413
Attentiveness	0.077	0.002	0.079
Mathematics Achievement	-	0.016	0.016
of Attentiveness			
on			
Parent Partic. (Interviews)	-	0.027	0.027
Attitude to Learning	0.310	0.001	0.311
Mathematics Achievement	0.196	-	0.196

Table 4.3 Relationships Among Secondary Student Variables (English): Standardised Direct, Indirect and Total Effects

Effects	Direct Effects	Indirect Effects	Total Effects
of Socio-Educational Level			
on			
Parent Partic. (Interviews)	0.122	-	0.122
English Homework	0.086	0.015	0.101
Attitude to Learning	0.149	0.045	0.194
Social Acceptance	0.106	0.004	0.110
Attentiveness	-	0.113	0.113
English Achievement	0.380	0.091	0.471
of Non-English-Speaking Background			
on			
Socio-Educational Level	-.128	-	-.128
English Homework	-.302	-.027	-.319
Attitude to Learning	-.123	-.096	-.218
Social Acceptance	-.105	-.012	-.117
Attentiveness	-	-.127	-.127
English Achievement	-	-.151	-.151
of Gender (Female)			
on			
English Homework	0.237	0.017	0.253
Attitude to Learning	0.416	0.066	0.482
Social Acceptance	0.121	-	0.121
Attentiveness	-	0.280	0.280
English Achievement	-	0.227	0.227
of Rural			
on			
Socio-Educational Level	-.128	-	-.128
English Homework	-.302	-.027	-.319
Attitude to Learning	-.123	-.096	-.218
Social Acceptance	-.105	-.012	-.117
Attentiveness	-	-.127	-.127
English Achievement	-	-.151	-.151
of Parent Participation (Interviews)			
on			
Attitude to Learning	0.068	0.006	0.074
of Homework			
on			
Attitude to Learning	0.182	-	0.182
Attentiveness	-	0.106	0.106
English Achievement	-	0.086	0.086
of Attitude to Learning			
on			
Attentiveness	0.581	-	0.581
English Achievement	-	0.470	0.470
of Social Acceptance			
on			
English Homework			
Attitude to Learning	0.137	-	0.192
Attentiveness	0.167	0.025	0.137
English Achievement	-	0.112	0.112
	-	0.091	0.091

of Attentiveness on English Achievement	0.809	-	0.809

Table 4.4 Relationships Among Secondary Student Variables (Mathematics): Standardised Direct, Indirect and Total Effects

Effects	Direct Effects	Indirect Effects	Total Effects
of Socio-Educational Level			
on			
Parent Partic. (Interviews)	0.104	-	0.104
Mathematics Homework	0.091	0.016	0.108
Attitude to Learning	0.119	0.068	0.186
Social Acceptance	0.120	0.002	0.122
Attentiveness	-	0.068	0.068
Mathematics Achievement	-	0.018	0.018
of Non-English-Speaking Background			
on			
Socio-Educational Level	-.216	-	-.216
Mathematics Homework	0.207	-.023	0.184
Attitude to Learning	0.156	-.005	0.151
Attentiveness	-	0.055	0.055
Mathematics Achievement	-	0.015	0.015
of Gender (Female)			
on			
Mathematics Homework	0.131	-	0.131
Attitude to Learning	0.445	0.019	0.464
Attentiveness	-	0.170	0.170
Mathematics Achievement	-	0.045	0.045
of Rural			
on			
Socio-Educational Level	-.157	-	-.157
English Homework	-.242	-.017	-.259
Attitude to Learning	-.140	-.065	-.205
Social Acceptance	-	-.019	-.019
Attentiveness	-	-.075	-.075
English Achievement	-	-.020	-.020
of Parent Participation (Interviews)			
on			
Attitude to Learning	0.045	0.009	0.054
of Homework			
on			
Attitude to Learning	0.148	-	0.148
Attentiveness	-	0.054	0.054
Mathematics Achievement	-	0.015	0.015
of Attitude to Learning			
on			
Attentiveness	0.367	-	0.367
Mathematics Achievement	-	0.098	0.098

of Social Acceptance			
on			
Mathematics Homework			
Attitude to Learning	0.132	-	-.132
Attentiveness	0.387	0.020	0.407
Mathematics Achievement	-	-	0.149
	-	-	0.040
of Attentiveness			
on			
English Achievement	0.267	-	0.267

Table 4.5 Relationships Among Teacher Variables: Direct, Indirect and Total Effects

Effects	Direct Effects	Indirect Effects	Total Effects
of Leadership Support			
on			
Peer Support	0.924	0.048	0.972
Role Clarity	0.786	0.185	0.970
Professional Development	0.992	-	0.992
Goal Congruence	1.051	-	1.051
Decision-Making	1.010	0.018	1.027
Student Orientation	-	0.843	0.843
Curriculum Coordination	-	0.982	0.982
Energy/Enthusiasm	-	0.478	0.478
Warmth	-	0.359	0.359
Morale	-	0.990	0.990
Feedback	-	0.913	0.913
Work Demands	-	-.268	-.268
Discipline Policy	-	0.819	0.819
of Goal Congruence			
on			
Morale	0.607	-	0.607
Discipline Policy	0.361	0.286	0.647
Student Orientation	0.758	-	0.758
Curriculum Co-ordination	0.638	-	0.638
of Professional Development			
on			
Energy	0.443	0.039	0.482
Feedback	0.921	-	0.921
Work Demands	-.270	-	-.270

Table 4.6 Predictors of Teacher Morale:

Predictors of Morale (Fixed Effects)	Standardised Regression Coefficients	Standard Errors
Goal Congruence	0.423	0.030
Leadership Support	0.225	0.031
Peer Support	0.234	0.029
Average School Leadership Support	0.111	0.032
Proportion of variance in Morale explained by:		
fixed effects:	72.7%	
other teacher effects:	23.1%	
school-level effects:	4.2%	

TECHNICAL NOTES

Calculation of composite variables and estimating their reliabilities using one-factor congeneric models

A composite variable is a single index of several constituent indicator variables, each of which has been weighted for its relative contribution to the composite. Composite variables in this study were calculated from one-factor congenric measurement models, using LISREL 7 (Jöreskog & Sörbom, 1989). Under a listwise method of deleting missing data, each one-factor model was analysed using a weighted least squares method of parameter estimation, based on a tetrachoric/polychoric/polyserial/product-moment intercorrelation matrix and an asymptotic covariance matrix of these correlations computed from PRELIS (Jöreskog & Sörbom, 1988). The measurement model for calculating a composite of the x variables may be written as

$$x = \Lambda_x \xi_1 + \delta, \tag{1}$$

and the variance-covariance matrix of x is

$$\Sigma = \Lambda_x \Phi \Lambda_x' + \Theta_\delta \tag{2}$$

From equation (1) x is a ($n \times 1$) vector of measurements on observed indicators, Λ_x is a ($n \times 1$) vector of fixed coefficients or loadings on an underlying latent (composite) variable (ξ_1) and δ is a ($n \times 1$) vector of unique (random) factors specifying the measurement errors in the x indicator variables. From equation (2) Σ is the estimated variance-covariance matrix of the factor loadings (λ_x) for the vector of congeneric measures (x), Φ is the correlation among the factors (for a one-factor model, $\Phi = 1$) and Θ_δ a vector of unique variances.

The reliability of an unweighted composite is given by

$$r_{xx} = \frac{\left(\hat{\Sigma} - \hat{\Theta}_\delta\right)}{\hat{\Sigma}}, \text{ and} \tag{3}$$

to maximise the reliability of the composite,

$$r_C = \frac{w_C'\left(\hat{\Sigma} - \hat{\Theta}_\delta\right)w_C}{w_C'\,\hat{\Sigma}\,w_C}, \tag{4}$$

where w_C is a vector of factor score regression weights ($w_1 = \lambda_{x1}/\theta_{\delta 1}$, $w_2 = \lambda_{x2}/\theta_{\delta 2}$, ..) that maximise the reliability of the composite. The reliability coefficients for all composite variables employed in the study, using equation (4), are provided in Tables 2.1 and 2.2 of Appendix 2.

Calibration of indicators for the English and Mathematics profiles using item response methodology

Detailed accounts of the procedures employed to develop the student achievement profiles used in this study have been provided by Griffin (1990), Griffin & Nix (1991) and Rowe (1992). For

illustrative purposes, following is a brief outline of those procedures as they relate to the calibration of the reading profiles.

Lists containing behavioural indicators of reading proficiency were provided to teachers in 22 schools. At the instigation of these teachers, a rating scale was introduced to indicate the level of confidence they had that any one indicator was exhibited by a student. Teachers correctly argued that the development of these indicators was more complex than a simple "present" or "absent" rating of a student's behaviour. By using a "partial credit" rating scale of 0, 1 and 2 to describe increasing evidence of an indicator being exhibited, teachers allowed for this possibility. Hence, for each indicator a zero (0) rating was used if the teacher had not observed a student exhibiting a performance indicator; a rating of one (1) was used to indicate that the behaviour was still developing and had yet to be consistently displayed by the student; and a two (2) was used if the teacher was confident that the indicator was an established part of the student's repertoire of reading behaviours. For practical purposes, the rating observation categories were labelled as "No" (0), "Maybe" (1) and "Yes" (2).

Data from more than 1200 students for the indicators were analysed using item response methodology as it applies to partial credit ratings (Adams & Khoo, 1992; Andrich, 1978; Masters, 1982). From Masters (1982), the probability (π_{xni}) of student n being rated x on the m_i-step (0, 1 or 2) for indicator i may be expressed as a function of the student's position β_n on the developmental attribute of reading proficiency and the difficulties (δ_{ij}) of the m_i-steps as follows:

$$\pi_{xni} = \frac{\exp \sum_{j=0}^{x} (\beta_n - \delta_{ij})}{\sum_{k=0}^{mi} \exp \sum_{j=0}^{k} (\beta_n - \delta_{ij})} \qquad x = 0, 1, 2\ (m_i\text{-steps}), \qquad (5)$$

where k refers to the number of individual step difficulties (two in this case). This enabled the indicators to be calibrated on a linear developmental scale (or growth continuum) expressed in *logits*, ranging from approximately -5 (easiest and lowest level of attribute development) to +5 (most difficult and highest level of attribute development).

The full list of indicators obtained from the analyses was examined in terms of their respective logit values on the developmental scale and for patterns that might be useful in summarising them into groups. It was decided to group the indicators into nine *bands*, labelled "A" to "I", with each group of indicators having a logit value range of approximately 1.5 logits. Band A was deliberately set at the earliest developmental level to avoid the association of "value" with development. Due to the empirical calibration of their constituent indicators using equation (5), the bands were designed to be **cumulative**. This is an important feature of the profiles which indicates that for a student whose mother tongue is English and is developing proficiencies at band E, for example, the student would also be likely to have established the behaviours described at lower band levels, but unlikely to have established proficiency at higher levels. For non-English speaking background students with well-developed reading skills in their mother tongue, trials of the reading profile bands indicated a pattern that showed "beginning" development across several band levels (*e.g.*, Rowe, 1991a).

Structural equation models for examining the relationships among student and teacher factors.

Separate models were fitted to the data for students and teachers using the LISREL method for Sub model 3b (Jöreskog & Sörbom, 1989:189-190). This general model contains only y

(observed) and η (latent or composite) variables. In fitting such models it was hypothesised that all variables essentially form part of an interdependent, endogenous system.

The structural relationships among the latent (composite) variables (η) are given by

$$\eta = \mathbf{B}\eta + \zeta \qquad (6)$$

and the covariance matrix of the *y* variables is

$$\Sigma = \Lambda y(\mathbf{I} - \mathbf{B})^{-1}\Psi(\mathbf{I} - \mathbf{B}')^{-1}\Lambda y' + \Theta\varepsilon \qquad (7)$$

This model has only four parameter matrices, namely, Λy , **B**, Ψ and $\Theta\varepsilon$, where Λy is the matrix of factor loadings for the *y* variables (absorbed in the one-factor composite variables denoted by η), **B** is the matrix of directional relationships among the latent endogenous constructs (η), Ψ is the matrix of variances and covariances among the residuals of the η variables, and $\Theta\varepsilon$ is the matrix of variances and covariances among the measurement errors ε associated with the *y* variables. The major interest in the models fitted for this study concerned the magnitude estimation of the direct, indirect and total effects for the parameters of **B**, provided in Tables 4.1 to 4.5 of Appendix 4.

For each of the structural equation models fitted, indices of the estimates for the fixed parameters (λ_c) of the composite variables were calculated from $\lambda_c = \sqrt{r_c}$, (from equation 4) and the fixed parameter estimates for the composites' unique (error) variances (Θ_c) were derived from $\Theta_c = (1 - r_c)$. For specific details of these procedures, see Alwin & Jackson (1980), Brown (1989), Jöreskog (1971), Munck (1979), Werts *et al.* (1978).

The fit statistics for each of the models shown diagrammatically in Figures 10 to 12 are shown in Table 5.1 below.

Table 5.1 Goodness-of-fit statistics for structural equation models estimating the relationships among student and teacher factors

Figure	Model	N	χ^2	d.f.	*p*	GFI	AGFI	RMR
10	Relationships among factors for primary students (English)	3913	5.82	16	0.971	1.000	0.999	0.017
10	Relationships among factors for primary students (Maths)	3859	7.84	17	0.970	1.000	0.999	0.046
11	Relationships among factors for secondary students (English)	2918	8.75	14	0.841	1.000	0.998	0.058
11	Relationships among factors for secondary students (Maths)	2582	22.43	17	0.160	0.999	0.996	0.041
12	Relationships among teacher factors	678	66.61	58	0.205	0.995	0.992	0.043

GFI - Goodnes-of-fit index; AGFI - Adjusted goodness-of-fit index; RMR - Root mean square residual

Multilevel models for partitioning the variance in response variables of interest, due to student- teacher- and school-level effects

The method used for estimating the proportion of variance in the response variables of interest (namely, student achievement outcomes) due to the clustering effects of students within classes/teachers within schools, was to fit simple two- and three-level models.

For each of the four response variables of interest, namely Primary English, Primary Mathematics, Secondary English and Secondary Mathematics, four models were fitted to the data:

(a) Two-level *variance-components model* (hereinafter referred to as "null model"), to estimate the variance due to the group effect of students (level 1) within schools (level 2), without any explanatory variables;
(b) Two-level model, as for (a), and student intake characteristics as fixed, level 1 explanatory variables;
(c) Three-level null model to estimate the variance due to the group effects of students (level 1) within clasesses/teachers (level 2), within schools (level 3) without any explanatory variables;
(d) Three-level model, as for (c), and student intake characteristics as fixed, level 1 explanatory variables.

The equations for the null models (a) and (c) may be illustrated with reference to the three-level model (c). Following Prosser, Rasbash & Goldstein (1991), this model was written in three parts. First, for the ith student in class/teacher j within school k, scores on English and Mathematics achievement (Y_{ijk}), were modelled as

$$Y_{ijk} = \beta_{0jk}X_0 + e_{ijk} \qquad (8)$$

In this model the slope is constant (0 - zero) but the intercept is random, varying across classes/ teachers and schools. The X_0 term in equation (8) is a column vector of unities representing the constant slope for classes/teachers and schools, and e_{ijk} is a random residual term representing the contribution to the response variable Y_{ijk} of the ith student in the jth class/teacher within the kth school.

Second, the intercept for class/teacher jk can be expressed as a linear function of the average intercept for school k (π_{00k}) and a class/teacher-level random term (u_{0jk}):

$$\beta_{0jk} = \pi_{00k} + u_{0jk} \qquad (9)$$

Third, the average intercept for school k can be modelled in terms of an overall school average intercept (γ_{000}), and a school-level random term (v_{00k}):

$$\pi_{00k} = \gamma_{000} + v_{00k} \qquad (10)$$

By combining equations (8), (9) and (10), a single equation version of the model can be written as follows:

$$Y_{ijk} = \gamma_{000} + (v_{00k} + u_{0jk} + e_{ijk}), \qquad (11)$$

where γ_{000} is the fixed part of the model and the three random terms are bracketed.

From equation (11), given the fixed part of the model (γ_{000} - the grand mean of Y_{ijk}), the random parameters that were estimated for this model were the variances of the residual terms in brackets, namely:

- the between-school variance estimate of the intercept (i.e., $\sigma^2_{(3)}$ for v_{00k});
- the between-classes/teachers variance of the intercept (i.e., $\sigma^2_{(2)}$ for u_{0jk}), and;
- the between-students, within classes/teachers and schools variance of the residual term (i.e., $\sigma^2_{(1)}$ for e_{ijk}).

The total variance due to random effects ($\sigma^2_{(T)} = \sigma^2_{(3)} + \sigma^2_{(2)} + \sigma^2_{(1)}$) may then be partititoned into that due to school, class/teacher and student effects as follows:

Proportion of variance due to:

school effects:	$\sigma^2_{(3)}/\sigma^2_{(T)}$
class/teacher effects:	$\sigma^2_{(2)}/\sigma^2_{(T)}$
student effects:	$\sigma^2_{(1)}/\sigma^2_{(T)}$

To adjust for student intake characteristics, in models (b) and (d), four explanatory variables were introduced as level 1 (student-level) fixed parameters. This may be illustrated with reference to the three-level model, in which the variables of, socio-educational level, gender, non-English-speaking background and rurality were fitted as explanatory variables and modelled as:

$$Y_{ijk} = \gamma_{000}X_0 + \gamma_{100}X_{1ijk} + \gamma_{200}X_{2ijk} + \gamma_{300}X_{3ijk} + \gamma_{400}X_{4ijk} + (v_{00k} + u_{0jk} + e_{ijk}), \quad (12)$$

where the variables X_{1ijk}, X_{2ijk}, X_{3ijk} and X_{4ijk} are the student-level measures of socio-educational level (SEL), gender (female) non-English-speaking background (NESB) and rurality respectively, and γ_{100} to γ_{400} are their related parameters to be estimated. γ_{000} is grand mean of the response variable of interest and X_0 is the intercept variable that takes the value 1 for all students.

Under an iterative generalised least squares method of estimation (see Goldstein, 1986), the models described by equations (11) and (12) were fitted to the data using ML3 (Prosser, Rasbash & Goldstein, 1991). The relevant results are summarised in Tables 4.7 and 4.8 (pp. 24-25), and shown graphically in Figure 14 (p. 25). Parameter estimates and their standard errors are given in Tables 5.2 and 5.3 in Appendix 5.

To illustrate variation in student achievement due to school effects (based on the data presented in Table 5.2), Figure 17 shows the two-level (students within schools), intake-adjusted, within-group regression lines for English achievement in each of the 57 primary schools. Each school is represented by a line segment whose end points indicate the school's minimum and maximum score. [To facilitate interpretation, *individual* students' English achievement scores (horizontal axis) and *school average* English achievement scores (vertical axis) have been standardised (Z-scores)]. The vertical distance from the horizontal axis to a given line segment is equal to the mean achievement for that school.

Similarly, to illustrate variation in student achievement due to class/teacher effects (from the data presented in Table 5.3), Figure 18 shows the intake-adjusted, within-group regression lines for English achievement in each of the 322 primary school class/teacher groups, with *class average* English achievement (standardised) shown on the vertical axis.

Table 5.2 Standardized Parameter Estimates for Two-Level Models of School and Student Effects

	Primary English 4205 students 57 schools		Primary Maths 4205 students 57 schools		Secondary English 3338 students 30 schools		Secondary Maths 2934 students 28 schools	
Parameter	**Est.**	*SE*	**Est.**	*SE*	**Est.**	*SE*	**Est.**	*SE*
Null Model (Variance Components):								
Random								
$\sigma^2_{(2)}$ (school)	**0.099***	*0.022*	**0.123***	*0.026*	**0.097***	*0.029*	**0.108***	*0.033*
$\sigma^2_{(1)}$ (student)	**0.900***	*0.020*	**0.886***	*0.019*	**0.914***	*0.022*	**0.923***	*0.024*
$\sigma^2_{(T)}$ (total)	**0.999**		**1.009**		**1.012**		**1.031**	
Intake-Adjusted Model:								
Fixed								
γ_{10} (SEL)	**0.182***	*0.016*	**0.171***	*0.016*	**0.175***	*0.022*	**0.200***	*0.020*
γ_{20} (gender: female)	**0.141***	*0.015*	**0.031***	*0.015*	**0.209***	*0.018*	**0.031**	*0.019*
γ_{30} (NESB)	**-.047***	*0.017*	**0.001**	*0.017*	**-.026**	*0.018*	**0.066***	*0.020*
γ_{40} (rural)	**0.029**	*0.035*	**0.112**	*0.038*	**.017**	*0.022*	**0.056***	*0.024*
Random								
$\sigma^2_{(2)}$ (school)	**0.086***	*0.019*	**0.111***	*0.024*	**0.066***	*0.020*	**0.084***	*0.026*
$\sigma^2_{(1)}$ (student)	**0.852***	*0.019*	**0.861***	*0.019*	**0.856***	*0.021*	**0.892***	*0.023*
$\sigma^2_{(T)}$ (total)	**0.938**		**0.972**		**0.922**		**0.975**	
σ^2 (fixed effects)[1]	**0.061**		**0.037**		**0.089**		**0.055**	
Proportion of variance in unadjusted scores due to:								
Intake effects	.061/.999=.061		.037/1.009=.037		.089/1.012=.088		.055/1.031=.054	
School effects	.086/.999=.086		.111/1.009=.110		.066/1.012=.066		.084/1.031=.081	
Other student effects	.852/.999=.853		.861/1.009=.853		.856/1.012=.846		.892/1.031=.865	
Proportion of variance in intake-adjusted scores due to:								
School effects	.086/.938=.092		.111/.972=.114		.066/.922=.072		.084/.975=.086	
Other student effects	.852/.938=.908		.861/.972=.886		.856/.922=.928		.892/.975=.914	

[1] Estimated as the difference between $\sigma^2_{(T)}$ (total) for the null and intake-adjusted models

* Statistically significant beyond the $p < 0.05$ level, by univariate two-tailed test.

Table 5.3 Standardized Parameter Estimates for Three-Level Models of School, Class/Teacher and Student Effects

	Primary English 4205 students 322 classes 57 schools		Primary Maths 4205 students 322 classes 57 schools		Secondary English 3338 students 216 classes 30 schools		Secondary Maths 2934 students 182 classes 28 schools	
Parameter	**Est.**	*SE*	**Est.**	*SE*	**Est.**	*SE*	**Est.**	*SE*
Null Model (Variance Components):								
Random								
$\sigma^2_{(3)}$ (school)	**0.037**	*0.020*	**0.028**	*0.022*	**0.047**	*0.059*	**0.000**	*0.000*
$\sigma^2_{(2)}$ (class/teacher)	**0.309***	*0.032*	**0.447***	*0.043*	**0.279***	*0.035*	**0.391***	*0.047*
$\sigma^2_{(1)}$ (student)	**0.644***	*0.015*	**0.537***	*0.012*	**0.701***	*0.018*	**0.615***	*0.016*
$\sigma^2_{(T)}$ (total)	**0.990**		**1.012**		**1.027**		**1.006**	
Intake-Adjusted Model:								
Fixed								
γ_{100} (SEL)	**0.181***	*0.014*	**0.165***	*0.013*	**0.170***	*0.017*	**0.183***	*0.017*
γ_{200} (gender: female)	**0.136***	*0.012*	**0.024***	*0.012*	**0.196***	*0.017*	**0.026***	*0.016*
γ_{300} (NESB)	**-.057***	*0.014*	**-.010**	*0.014*	**-.031**	*0.017*	**0.048***	*0.017*
γ_{400} (rural)	**-.017**	*0.014*	**0.039**	*0.038*	**-.019**	*0.021*	**0.057***	*0.021*
Random								
$\sigma^2_{(3)}$ (school)	**0.021**	*0.017*	**0.014**	*0.019*	**0.032**	*0.021*	**0.000**	*0.000*
$\sigma^2_{(2)}$ (class/teacher)	**0.309***	*0.031*	**0.445***	*0.042*	**0.267***	*0.033*	**0.373***	*0.045*
$\sigma^2_{(1)}$ (student)	**0.597***	*0.014*	**0.516***	*0.012*	**0.649***	*0.016*	**0.590***	*0.016*
$\sigma^2_{(T)}$ (total)	**0.927**		**0.975**		**0.948**		**0.962**	
σ^2 (fixed effects)[1]	**0.063**		**0.037**		**0.079**		**0.043**	
Proportion of variance in unadjusted scores due to:								
Intake effects	.063/.990=.063		.037/1.012=.036		.079/1.027=.077		.043/1.006=.043	
School effects	.021/.990=.021		.014/1.012=.014		.032/1.027=.031		.000/1.006=.000	
Class/teacher effects	.309/.990=.312		.445/1.012=.440		.267/1.027=.260		.373/1.006=.370	
Other student effects	.597/.990=.585		.516/1.012=.510		.649/1.027=.632		.590/1.006=.586	
Proportion of variance in intake-adjusted scores due to:								
School effects	.021/.927=.023		.014/.975=.015		.032/.948=.034		.000/.962=.000	
Class/teacher effects	.309/.927=.333		.445/.975=.456		.267/.948=.281		.373/.962=.387	
Other student effects	.597/.927=.644		.516/.975=.529		.649/.948=.685		.590/.962=.613	

[1] Estimated as the difference between $\sigma^2_{(T)}$ (total) for the null and intake-adjusted models

* Statistically significant beyond the $p < 0.05$ level, by univariate two-tailed test.

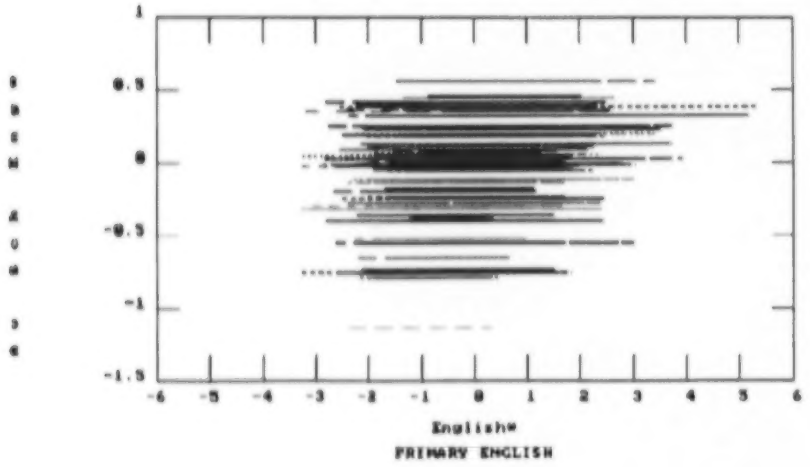

Figure 17. Variation in English achievement for 57 primary schools

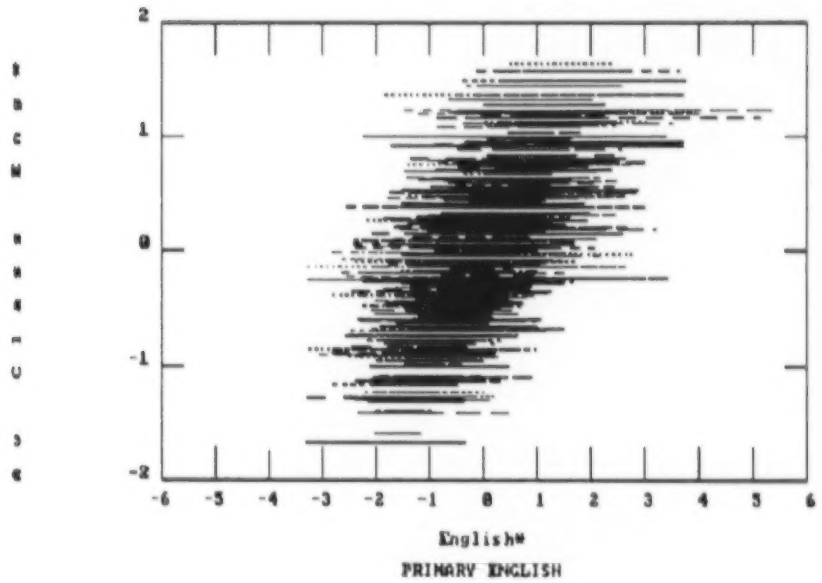

Figure 18. Variation in English achievement for 322 class/teacher groups

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Two-level models were also fitted to the teacher data, both for the purposes of predicting teacher morale in terms of teacher and school-level explanatory variables (Figure 13, p. 23 and Table 4.6, p. 52) and for estimating the proportion of variance in the dimensions of teachers' affect and perceptions of their work environment due to both teacher- and school-level effects. Table 5.4 summarises the results of fitting variance components models for each of the affect and work environment dimensions, to estimate the proportion of variance in each dimension due to school effects.

Table 5.4 Per cent of Variance in Teacher Affect and Work Environment Dimensions Due to Between-School Differences

Dimension	Primary 322 teachers* 57 schools	Secondary 356 teachers* 27 schools
Energy/Enthusiasm	9.1	6.9
Warmth (towards students)	0.0	3.6
Morale	33.2	18.5
Feedback	19.4	10.5
Work Demands	24.2	9.5
Leadership Support	28.6	14.2
Discipline Policy	28.8	29.9
Peer Support	20.6	10.2
Role Clarity	11.4	7.1
Professional Development	23.8	17.1
Goal Congruence	30.7	19.4
Decision Making	20.9	12.1
Student Orientation	24.9	14.5
Curriculum Coordination	27.0	8.5

* Teacher questionnaire returns with complete data

Table 5.5 presents the detailed results of the two-level model fitted to predict teacher morale in terms of the teacher and school-level explanatory variables illustrated in Figure 13 (p. 23) and summarised in Table 4.6 (p. 52).

Table 5.5 Variation in Teacher Morale due to School- and Teacher-Level Effects Showing Unstandardised and Standardised Parameter Estimates and Standard Errors (678 teachers in 84 schools)

Explanatory Variables/ Parameters	Unstandardised Est.	*SE*	Standardised Est.	*SE*
Null Model: (Random Parameters)				
$\sigma^2_{(2)}$ (school)	**0.34***	*0.07*	**0.38***	*0.08*
$\sigma^2_{(1)}$ (teacher)	**0.63***	*0.04*	**0.70***	*0.04*
$\sigma^2_{(T)}$ (total)	**0.97**		**1.08**	
Proportion of variance in Morale due to: school effects	**.352**			
teacher effects	**.648**			
Explanatory Model:				
FIXED				
γ_{00} (Constant)	**3.70**	*0.03*	**0.01**	*0.03*
γ_{10} (Leadership support)	**0.21***	*0.03*	**0.23***	*0.03*
γ_{20} (Peer support)	**0.25***	*0.03*	**0.23***	*0.03*
γ_{30} (Goal congruence)	**0.45***	*0.03*	**0.42***	*0.03*
γ_{01} (Sch. av. Leader. support)	**0.17***	*0.05*	**0.11***	*0.03*
RANDOM				
$\sigma^2_{(2)}$ (school)	**0.04***	*0.01*	**0.05***	*0.01*
$\sigma^2_{(1)}$ (teacher)	**0.22***	*0.01*	**0.25***	*0.01*
$\sigma^2_{(T)}$ (total)	**0.26**		**0.30**	
σ^2 (fixed effects)[1]	**0.70**		**0.78**	
Proportion of variance in Morale- due to: fixed effects	701/ 966= .726		784/1.079= .726	
school effects	.042/ 966= .043		.046/1.079= .043	
other teacher effects	223/ 966= .231		249/1.079= .231	

[1] Estimated as the difference between $\sigma^2_{(T)}$ (total) for the null and explanatory models

* Statistically significant beyond the $p < 0.05$ level, by univariate two-tailed test.

Notes on multi-level and structural equation modelling

One of the advantages of fitting structural equation models (SEM) to data of the present kind is that they can account for measurement error in both the observed and latent variables, as well as provide a means of estimating the magnitude of direct, indirect and interdependent effects among those latent variables. Despite these advantages, however, SEM approaches to analysis assume that the sample variables measured, regardless of level, are independently distributed in a multivariate population. That is, a SEM model assumes *single-level* data, and there is no simple adjustment of the structural modelling framework that can be made in order to deal with non-independent observations (Cuttance & Ecob, 1987).

On the other hand, despite the utility of fitting multi-level models to hierarchically structured data, typical of school effectiveness research, current multi-level modelling computer program applications also have limitations. Drawbacks in their use at this stage are that they cannot cope with the estimation of interdependent effects among multiple response and explanatory variables (observed or latent); moreover, like the simple *general linear model*, they assume that explanatory variables are measured without error. In fact, Scheerens (1993:31) notes:

> The usual LISREL-type and multi-level models that are applied to the analysis of school effectiveness research data are considered to be closed models. When techniques that can handle the combination of these two approaches become available, we will have come a long way in closing the gap between conceptual and formal mathematical models of school effectiveness.

Nevertheless, important theoretical work on developing techniques to analyse multi-level covariance structure data has already been done (*e.g.*, Goldstein & McDonald, 1988; McDonald & Goldstein, 1989) and the availability of relevant computer software packages is imminent.